THE Petroleum Engineer

JANUARY 1936

VOLUME VII NUMBER IV

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

California Natural Gasoline Association—February 6, Richfield Building, Los Angeles.

American Institute of Mining and Metallurgical Engineers, Annual Meeting—February 17, 18, 19, 20, and 21, Engineering Societies Building, New York City.

Mid-Continent District Petroleum Division of A.P.I., Spring Meeting—February 20 and 21, Wichita, Kansas.

American Society for Testing Materials, Regional Meeting—March 4, William Penn Hotel, Pittsburgh, Pennsylvania.

Western Petroleum Refiners Association, Annual Meeting—April 9 and 10, Excelsior Springs, Missouri.

Petroleum Industry Electrical Association—April 11, 12, and 13, Tulsa, Oklahoma.

American Chemical Society, Petroleum Division, Symposium on Motor Fuels—April 13-17, Kansas City, Mo.

Oil Equipment and Engineering Exposition—April 20, 21, 22, 23, 24, and 25, Houston, Texas.

Natural Gasoline Association of America, Annual Meeting—May 13, 14, and 15, Mayo Hotel, Tulsa, Oklahoma.

American Petroleum Institute, Mid-Year Meeting—May 13, 14, and 15, Tulsa, Oklahoma.

International Petroleum Exposition—May 16-23, Tulsa, Oklahoma.

Independent Petroleum Association of America, Mid-Year Meeting—May 21, Tulsa, Oklahoma.

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SUBSCRIPTION PRICE — Single copies 15 cents. Domestic and foreign, $1.00 per year, three years $2.00.

THE PETROLEUM ENGINEER PUBLISHING COMPANY

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Sales of Nordstrom Valves for 1935 reflect the largest increase in the history of our Company. This widespread acceptance of our Product in the oil and gas industry has been made possible by the loyal support of our customers. We are proud of the faith and high regard you hold for Nordstrom Valves. May we take this opportunity to express our genuine appreciation of your patronage and our determination to serve you even better than before.

This Company is 100% independently owned. No oil or gas company owns any of our stock nor is this Company affiliated with any oil or gas company. We make only ONE product—Lubricated Plug Valves. They HAVE to work satisfactorily or our Company couldn't exist. The continued growth of the Company and the millions of dollars worth of Nordstroms in service are significant of the excellence of our product.

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Chief Engineer and Inventor

FRANK B. WOLFE
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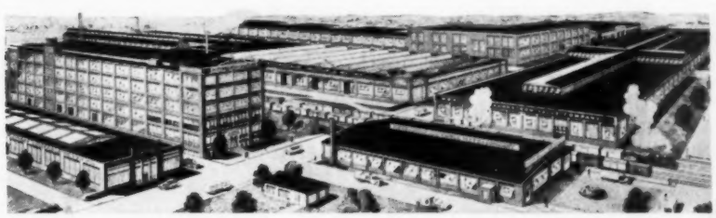

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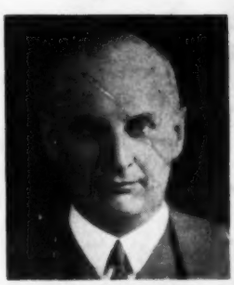

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THE PENALTY OF LEADERSHIP

In every field of human endeavor, he that is first must perpetually live in the white light of publicity. ¶ Whether the leadership be vested in a man or in a manufactured product, emulation and envy are ever at work. ¶ In art, in literature, in music, in industry, the reward and the punishment are always the same. ¶ The reward is widespread recognition; the punishment, fierce denial and detraction. ¶ When a man's work becomes a standard for the whole world, it also becomes a target for the shafts of the envious few. ¶ If his work be merely mediocre, he will be left severely alone—if he achieve a masterpiece, it will set a million tongues a-wagging. ¶ Jealousy does not protrude its forked tongue at the artist who produces a commonplace painting. ¶ Whatsoever you write, or paint, or play, or sing, or build, no one will strive to surpass or to slander you, unless your work be stamped with the seal of genius. ¶ Long, long after a great work or a good work has been done, those who are disappointed or envious continue to cry out that it cannot be done. ¶ Spiteful little voices in the domain of art were raised against our own Whistler as a mountebank, long after the big world had acclaimed him its greatest artistic genius. ¶ Multitudes flocked to Bayreuth to worship at the musical shrine of Wagner, while the little group of those whom he had dethroned and displaced argued angrily that he was no musician at all. ¶ The little world continued to protest that Fulton could never build a steamboat, while the big world flocked to the river banks to see his boat steam by. ¶ The leader is assailed because he is a leader, and the effort to equal him is merely added proof of that leadership. ¶ Failing to equal or to excel, the follower seeks to depreciate and to destroy—but only confirms once more the superiority of that which he strives to supplant. ¶ There is nothing new in this. ¶ It is as old as the world and as old as the human passions—envy, fear, greed, ambition, and the desire to surpass. ¶ And it all avails nothing. If the leader truly leads, he remains—the leader. ¶ Master-poet, master-painter, master-workman, each in his turn is assailed, and each holds his laurels through the ages. ¶ That which is good or great makes itself known, no matter how loud the clamor of denial. ¶ That which deserves to live—lives.

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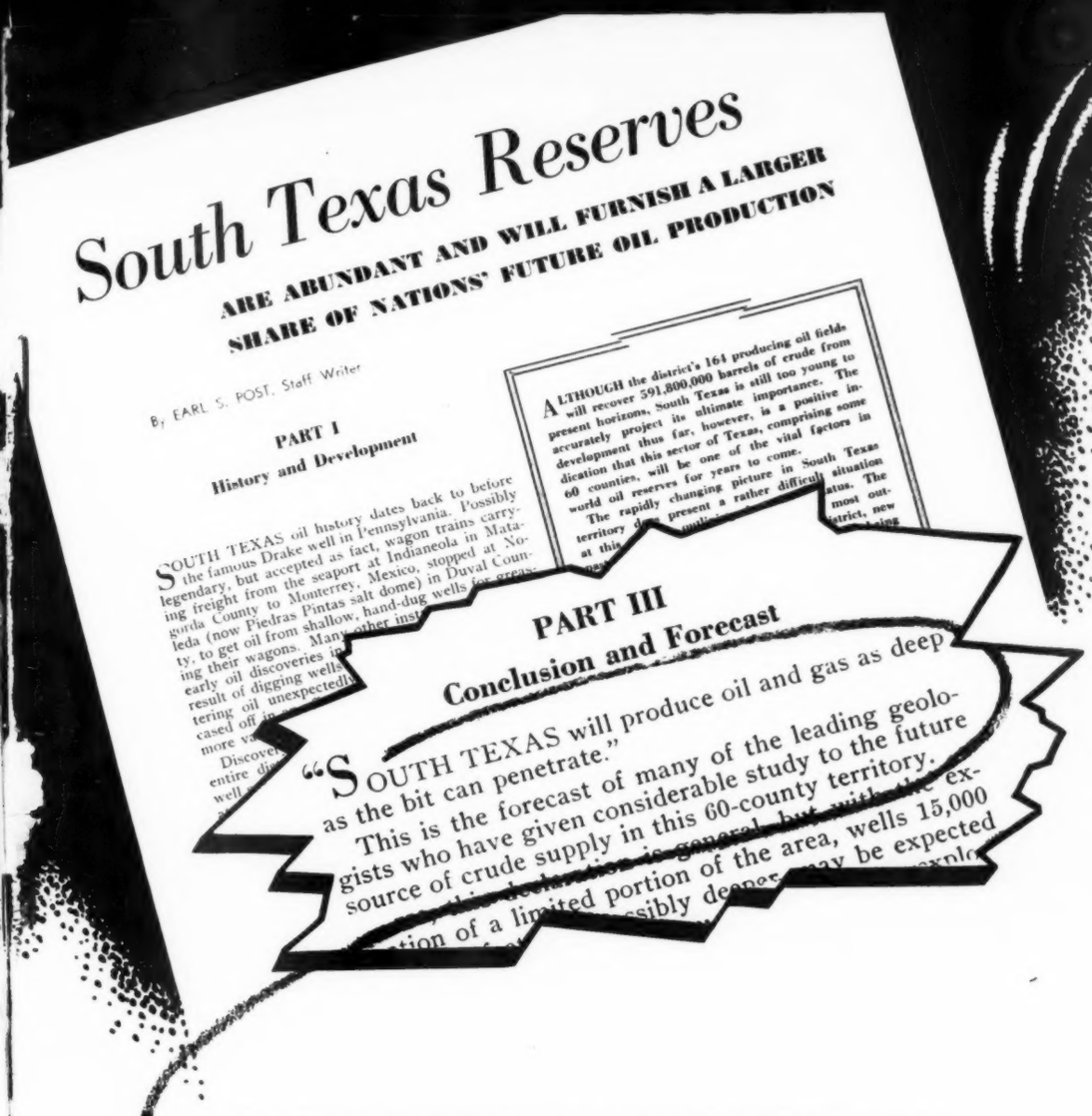
South Texas Reserves
ARE ABUNDANT AND WILL FURNISH A LARGER SHARE OF NATIONS' FUTURE OIL PRODUCTION
By EARL S. POST, Staff Writer
PART I
History and Development
SOUTH TEXAS oil history dates back to before the famous Drake well in Pennsylvania. Possibly legendary, but accepted as fact, wagon trains carrying freight from the seaport at Indianeola in Matagorda County to Monterrey, Mexico, stopped at Nopaleda (now Piedras Pintas salt dome) in Duval County, to get oil from shallow, hand-dug wells for greasing their wagons.
ALTHOUGH the district's 164 producing oil fields will recover 591,800,000 barrels of crude from present horizons, South Texas is still too young to accurately project its ultimate importance. The development thus far, however, is a positive indication that this sector of Texas, comprising some 60 counties, will be one of the vital factors in world oil reserves for years to come.
The rapidly changing picture in South Texas
territory
PART III
Conclusion and Forecast
"SOUTH TEXAS will produce oil and gas as deep as the bit can penetrate."
This is the forecast of many of the leading geologists who have given considerable study to the future source of crude supply in this 60-county territory.
tion of a limited portion of the area, wells 15,000

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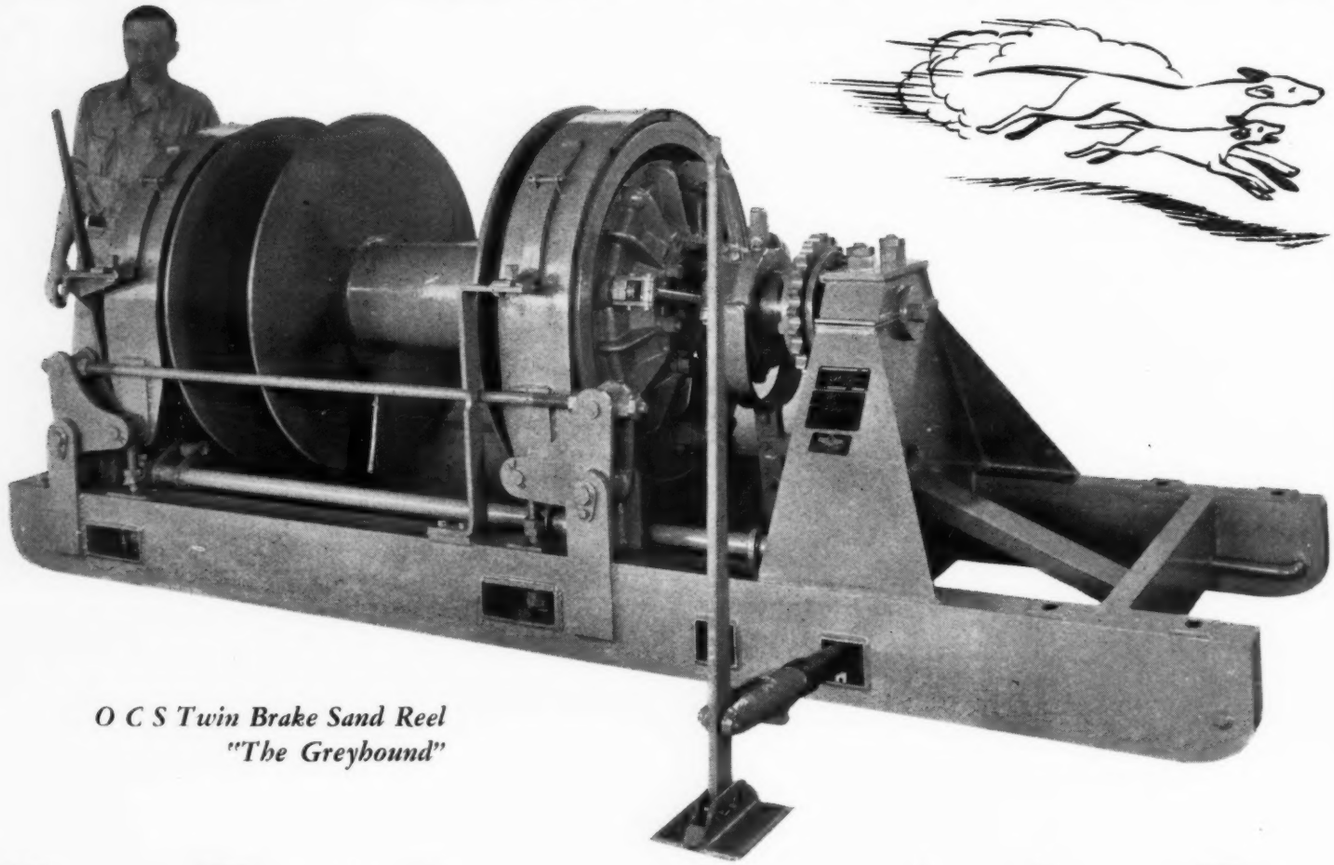

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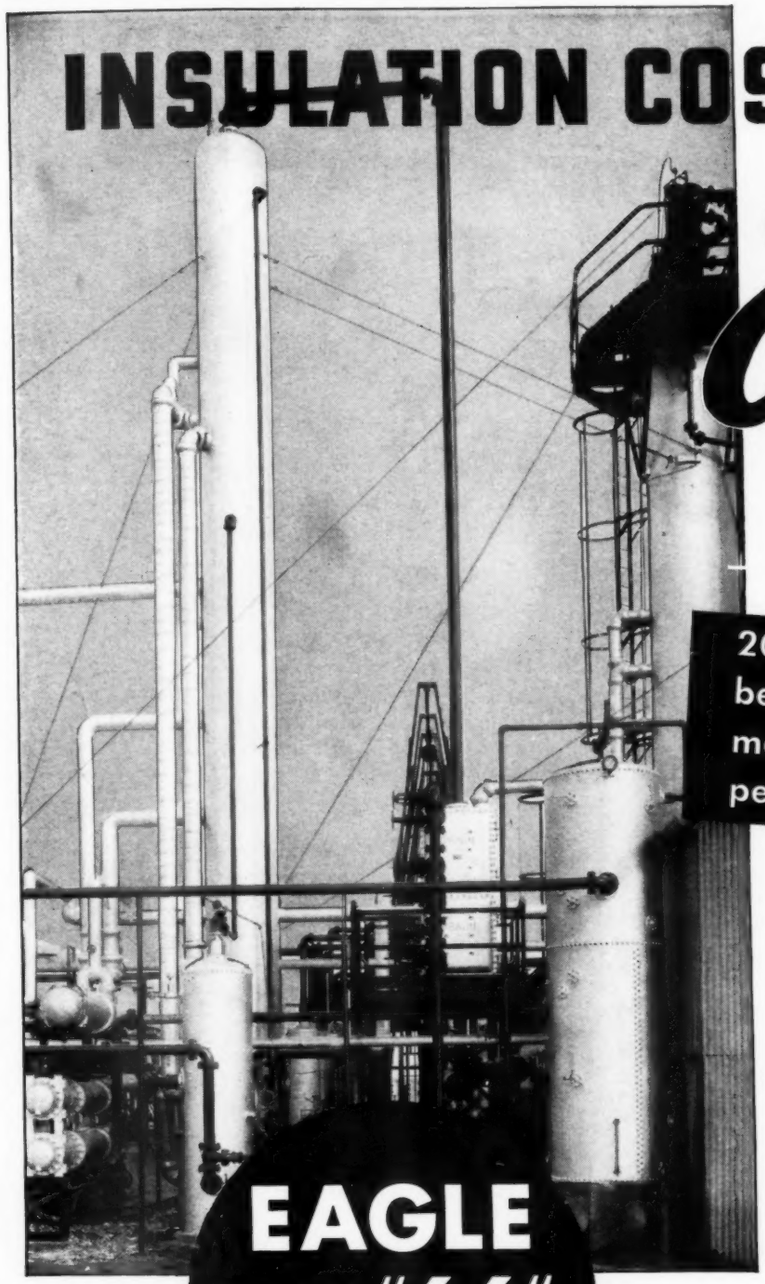

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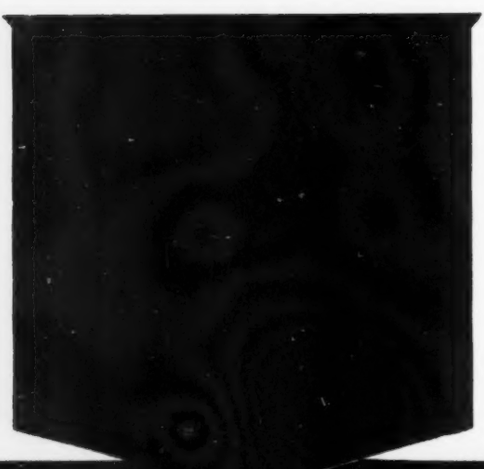
you will not Begrudge it

9th INTERNATIONAL PETROLEUM EXPOSITION

1936 Budget - Sales Expense

TULSA May 16-23, 1936



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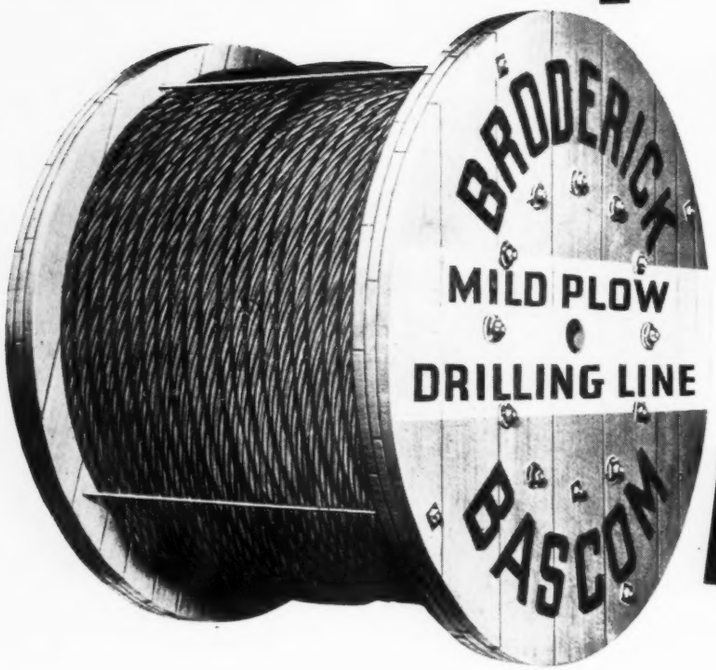

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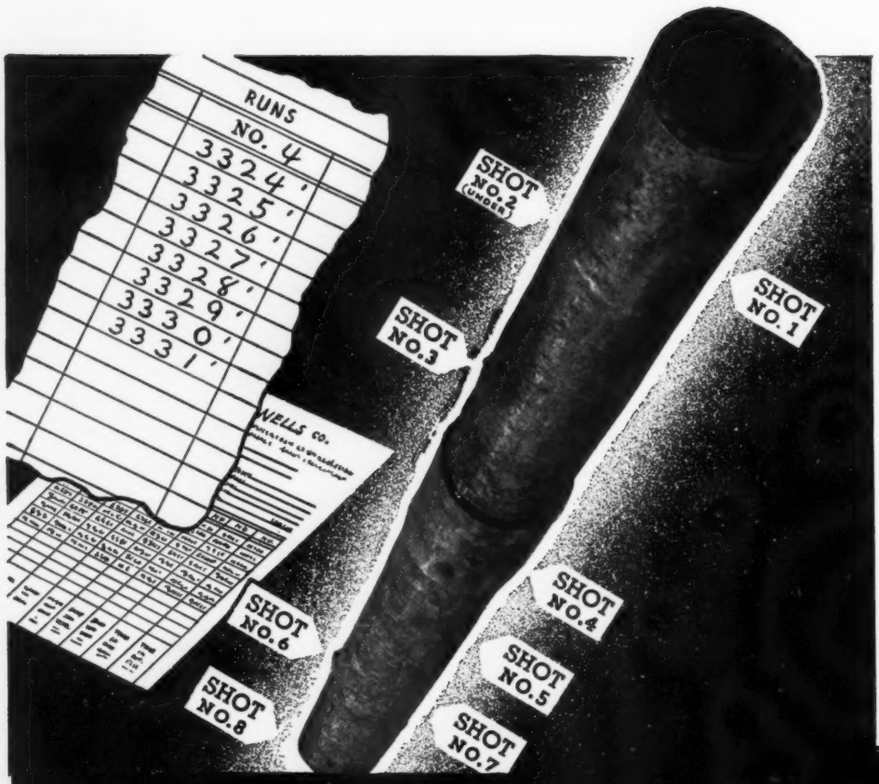

• AT THE LEFT is an unretouched photograph of a section of 6⅝"-26-lb. casing recently pulled from the well of a major oil company after Gun-Perforating below 3300 feet and sent to us by company officials...Note clean, round-hole perforations and accuracy of spacing at one-foot intervals. . . Interesting proof of our accurate shooting, even though Gun Perforator was in motion and shots were individually fired...Note also distribution of shots around casing, making good drainage area on all sides.

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• GUN PERFORATOR ACCURACY has been PROVED time and again by examining sections of casing as above; also by checking bottom with drill pipe and sand line measurements, in wells from 2000 to 9000 feet in depth. . . Just one more reason why Lane-Wells Gun Perforator Service has become standard practice with hundreds of oil companies. Consult the Lane-Wells office nearest you for details.

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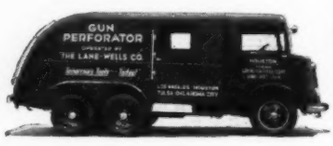

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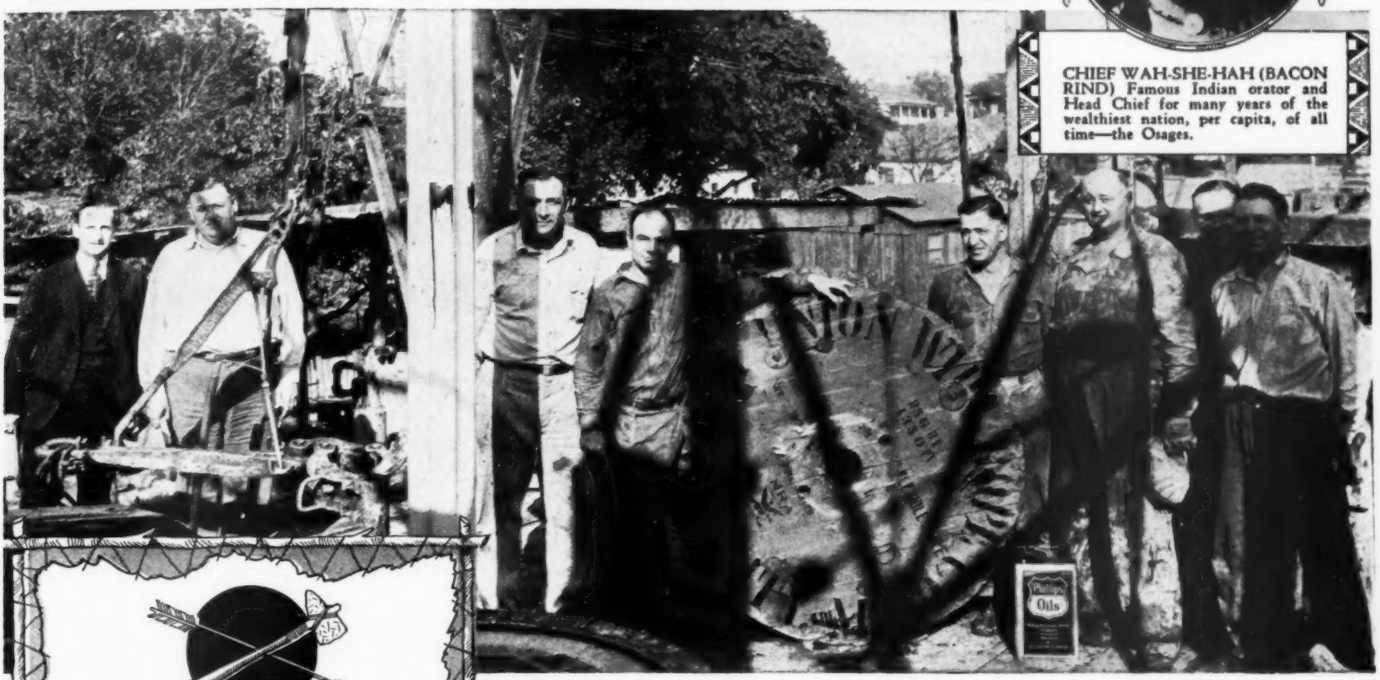

A WARLIKE TRIBE

The Osages—early Oklahomans, not one of the imported tribes—visited in 1839 by Geo. Catlin, noted traveler among the Indians—were reported as the tallest race in North America. "Few under 6 feet—many 6½ and 7 feet tall—well built—good looking."

Noting a peculiarity of their heads, he discovered that as babies they were carried on boards, with head bound down so tightly as to cause more than a natural elevation on the top of the head. He was told this pressed out a "bold and manly appearance in front." He reported them as "a warlike tribe, much reduced now, but they still fight the Comanches and Pawnees and get the worst of it."

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UNION LINES are in demand for deep drilling. This picture was taken in deep territory — the Oklahoma City field — Phillips Petroleum Company Etta No. 1, being drilled by Earl Wherry, contractor. The men, left to right, are: J. A. Undercofler, Union Wire Rope Corp.; Earl Wherry, contractor; Guy Steward, driller; Doc Joiner, derrickman; C. L. Post, cathead man; Tiney Souther, pipe-racker; Chas. Wherry, back-up man; R. P. Burge, foreman.

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South Chester Methods

make pipe dreams

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An oil field man on a recent plant visit remarked on the number of men who were "only looking"—"looking" at Chester Pipe at every stage of its making—inspecting it with that degree of thoroughness that has made Chester Pipe a leader in the field.

Chester also makes "Wrought Iron" pipe—manufactured from genuine old-fashioned hand puddled muck bar made in our own mills from 100 per cent pig iron.

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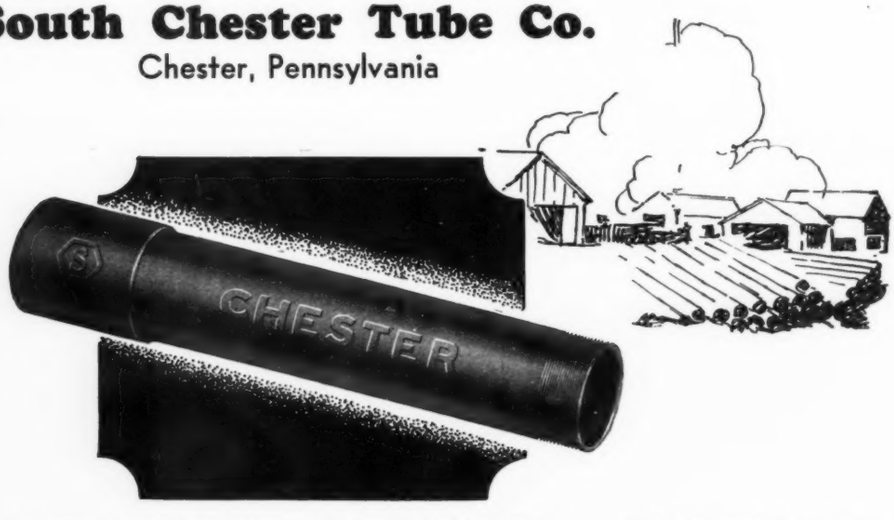

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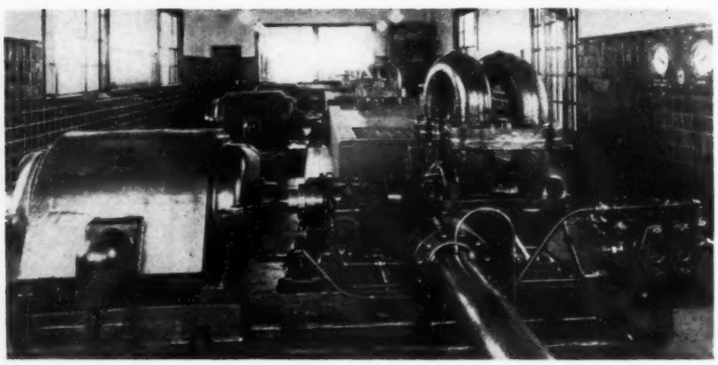

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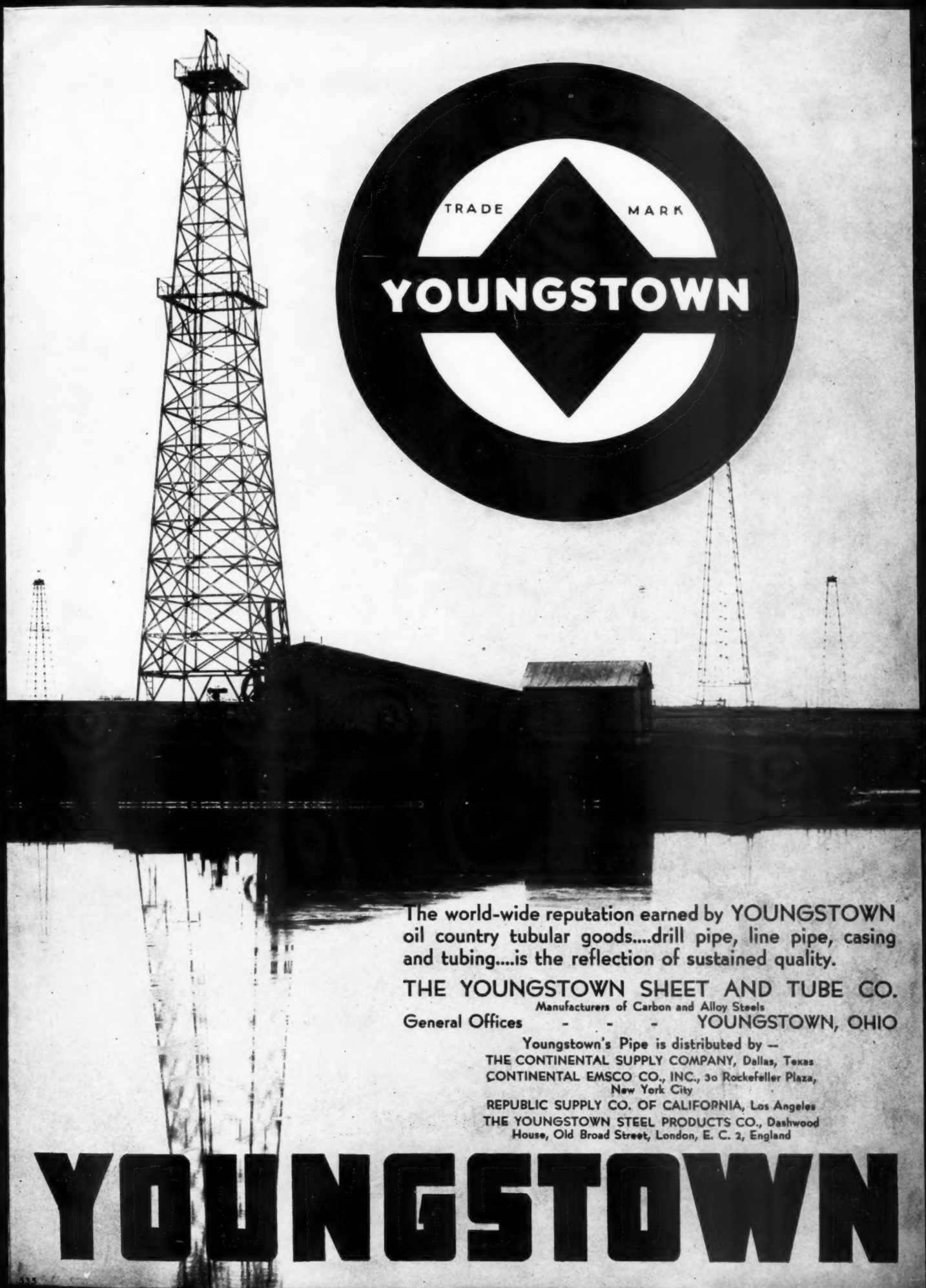

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CORRECT PRINCIPLE

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THE Petroleum Engineer

JANUARY 1936 VOLUME VII NUMBER IV

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

California Natural Gasoline Association—February 6, Richfield Building, Los Angeles.

American Institute of Mining and Metallurgical Engineers, Annual Meeting—February 17, 18, 19, 20, and 21, Engineering Societies Building, New York City.

Mid-Continent District Petroleum Division of A.P.I., Spring Meeting—February 20 and 21, Wichita, Kansas.

American Society for Testing Materials, Regional Meeting—March 4, William Penn Hotel, Pittsburgh, Pennsylvania.

Western Petroleum Refiners Association, Annual Meeting—April 9 and 10, Excelsior Springs, Missouri.

Petroleum Industry Electrical Association—April 11, 12, and 13, Tulsa, Oklahoma.

American Chemical Society, Petroleum Division, Symposium on Motor Fuels—April 13-17, Kansas City, Mo.

Oil Equipment and Engineering Exposition—April 20, 21, 22, 23, 24, and 25, Houston, Texas.

Natural Gasoline Association of America, Annual Meeting—May 13, 14, and 15, Mayo Hotel, Tulsa, Oklahoma.

American Petroleum Institute, Mid-Year Meeting—May 13, 14, and 15, Tulsa, Oklahoma.

International Petroleum Exposition—May 16-23, Tulsa, Oklahoma.

Independent Petroleum Association of America, Mid-Year Meeting—May 21, Tulsa, Oklahoma.

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SUBSCRIPTION PRICE — Single copies 15 cents. Domestic and foreign, $1.00 per year, three years $2.00.

THE PETROLEUM ENGINEER PUBLISHING COMPANY
Tower Petroleum Building
DALLAS, TEXAS

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Rockville Center
Long Island, N. Y.

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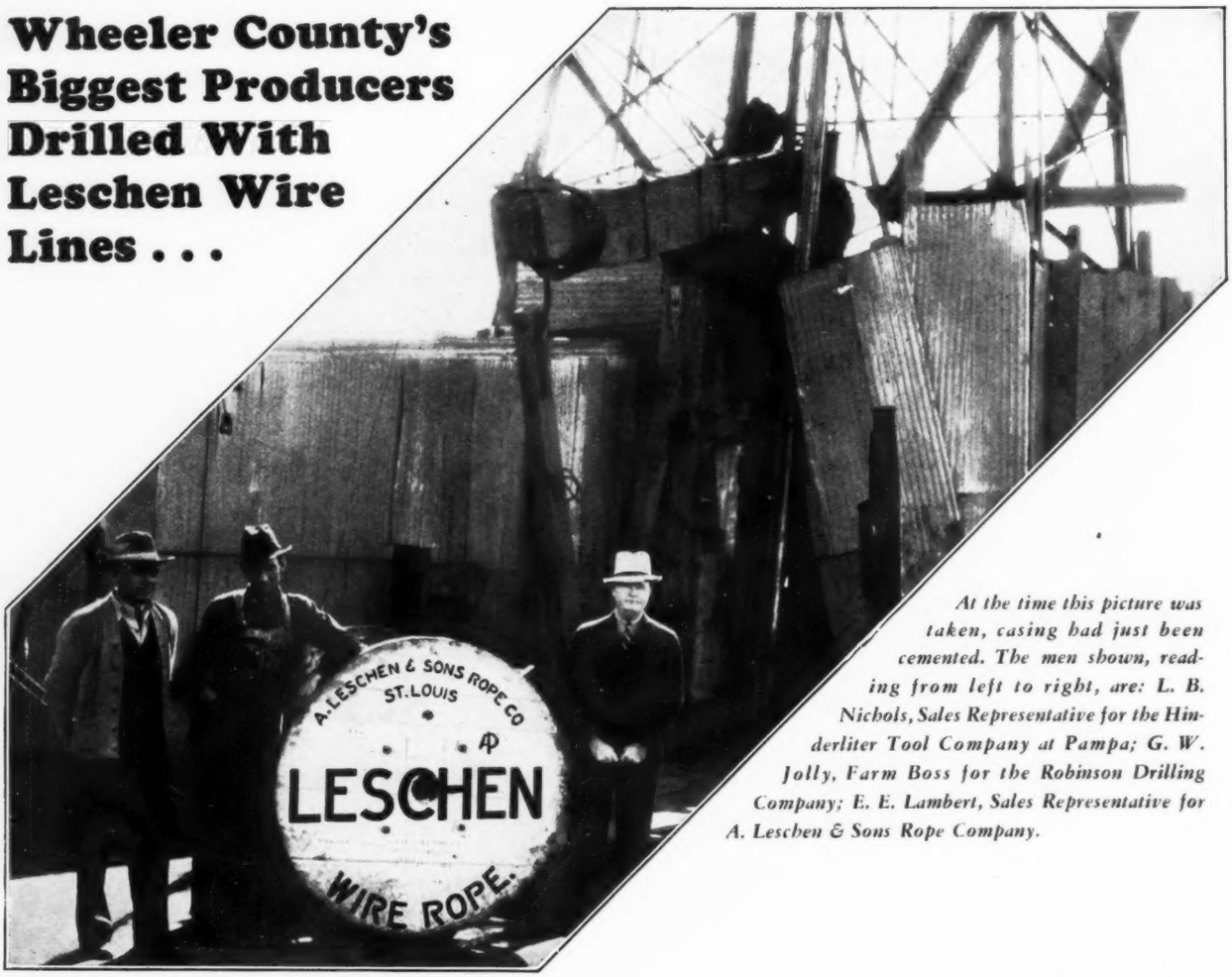

At the time this picture was taken, casing had just been cemented. The men shown, reading from left to right, are: L. B. Nichols, Sales Representative for the Hinderliter Tool Company at Pampa; G. W. Jolly, Farm Boss for the Robinson Drilling Company; E. E. Lambert, Sales Representative for A. Leschen & Sons Rope Company.

The accompanying illustration pictures the Robinson Drilling Company's Well No. 3 on the G. W. Sitter A-Lease at Kellerville in Wheeler County, Texas, which is being drilled with a "California Special" Drilling Line. This well is expected to be even larger than the 6,000 barrel producer recently brought in by this company on this same lease.

Mr. Lew Robinson of the Robinson Drilling Company has used Leschen Lines exclusively for the past three years and is high in his praise of them. Like all successful drillers, Mr. Robinson knows the importance of using wire lines that are *consistently* dependable and long lasting.

More and more users of Standard Tool rigs are switching to "California Special" Drilling Lines in West Texas and the Panhandle because the drilling there is tough and the lines used must be able to take a lot of punishment. All Leschen Lines, whether for Cable Tool or Rotary drilling, are designed and made for the particular work they are to do. Why not try a Leschen Line on your next purchase? Carried in field stocks at active points.

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The Course of Oil

By K. C. SCLATER

Promising Outlook For 1936

During the year 1935 the petroleum industry has made substantial gains toward economic stability. Will these gains be consolidated and augmented during the year 1936? There is every reason to believe that they will, for at no time in more than two decades has the statistical position of the industry looked so favorable as it does at present. In this connection, attention is directed to a statistical review of the petroleum industry for 1935 in this issue, by William J. Kemnitzer, petroleum technologist, who is also a sagacious analyst of petroleum statistics.

The recent general advance in crude prices in the Mid-Continent, Texas, and Gulf Coast fields is the first in almost two and a half years. Such an advance at this season of the year presages a trend toward a normal crude price level that is more in keeping with the improved statistical position, and it is so hailed with confidence throughout the industry.

Faced with the fact that the potential supply of crude is still far in excess of the consumptive demand, and likely to be so for some time to come, the industry realizes that continued improvement therefore must be contingent upon the control of production to requirements and upon refiners regulating their runs to stills on a sound economic basis.

A new advisory regulatory body, the Interstate Compact Commission, formed during the past year, is now beginning to function, so further improvement in the allocation of state allowables should be forthcoming. Still further effective aid in this connection is in prospect. The American Petroleum Institute may supplement the work of the Bureau of Mines by forming a committee of twelve leading economists, whose task it would be to estimate in advance quarterly the demand for petroleum products. Should this proposal be carried out it would remove the oft-repeated objection that the industry as a whole has always been delinquent in recognizing business trends.

Dissension Over Acreage Factor

The East Texas field shows no signs of relinquishing the lead it has held these last few years as a potential producer of oil. Despite the dominant position this field holds methods of proration are still a bone of contention among operators there.

East Texas operators cannot see eye-to-eye on the method of prorating their wells. The acreage factor is the subject of wide dissension and one over which a bitter fight soon may ensue. In the face of court decisions and also an abundance of engineering evidence submitted at hearings the State Railroad Commission has not yet seen fit to include acreage in any form in its proration orders for the East Texas field. Yet it would seem that only in this way (i.e. by the consideration of acreage) can be avoided an irrational program of dense drilling that will be an ultimate detriment to the field—a consequence that the regulatory body surely cannot fail to foresee.

Another paradoxical angle to the situation in the East Texas field is the fact that many operators opposed to considering the acreage factor for prorating a well's production are also clamoring for an increased allowable for the field. Those operators, in opposing the acreage factor, are aggravating their own problems by deliberately seeking to encourage closer well-spacing, a move that if persisted in successfully, must result eventually in a reduced allowable per well.

About the only defense one hears such operators and their followers voice against consideration of acreage is that closer spacing will recover more oil. Though palpable, the false economy of drilling more wells than necessary seems to be ignored entirely. Apparently, it is no concern of the regulatory officials how many wells are drilled or at what cost, so long as the maximum ultimate recovery of oil is obtained. As a result of following this fallacious policy of regulation, many companies will be forced to drill more wells than technical knowledge shows to be necessary.

One of the prime requisites for equitable proration in any field is a well-spacing program dictated by sound economy, and by engineering principles of reservoir control. The absence of this one requisite in East Texas is at the root of the trouble over proration.

Lack of knowledge of reservoir conditions in the East Texas field in the early stages of development no doubt was largely responsible for the vacillating policy of regulation under which the field was developed, particularly in regard to well-spacing. As a result, strict adherence to a uniform well-spacing became well-nigh impossible, so that today, great discrepancies in well-spacing between adjoining leases are to be found in every section of the field. An acreage factor in proration regulations, even at this late date, would affect adversely—probably, in many cases, not more than the circumstances warrant—the interests of owners of wells on small tracts. Naturally, these owners are opposed to an acreage factor.

Unless some means of checking too dense a drilling program for the field is applied, well allowables must be reduced eventually to the point that an increase in allowable will become imperative. Such a course will shorten the economic life of the field, for the cost of lifting the oil will be much greater than had the field allowable been restricted to that which available subsurface data on reservoir conditions show to be reasonable.

« « « HIGHLIGHTS IN OILDOM » » »

General Crude Price Advance

After almost two years of waiting, operators of the Mid-Continent, Wyoming, Ohio, Illinois and Kentucky, saw a hope realized when early in January general crude price advances were announced by the major purchasers in those areas. The increases amounted to from 5 cents to 25 cents a barrel.

The Sun Oil Company took the initiative when on January 8 officials of that company announced advances of 5 cents to 15 cents a bbl., effective January 9, for fields of Texas and the Gulf Coast of Louisiana. The price increase for East Texas and Conroe was 15 cents, and for the Gulf Coast districts of Texas and Louisiana, 10 cents. The Sun's lead was quickly followed by others, and extended to apply throughout the Mid-Continent. The Stanolind Crude Oil Purchasing Company took the lead in Oklahoma and Kansas, advancing prices 10 cents a barrel. Price increases also went into effect in North Louisiana and Arkansas, the schedules of the purchasers showing a slight variation there, but for the most part representing increases of from 5 cents to 10 cents a barrel. In Illinois, West Kentucky, five Wyoming fields, Elk Basin, Big Muddy, Grass Creek, Rock Creek, Salt Creek, and the Lima district of Ohio the advance amounted to 10 cents a barrel.

•

Petroleum Reserves Estimated

Proven underground reserves of petroleum in known fields of the United States are estimated at more than 12,177,000,000 bbl. by the American Petroleum Institute. The estimate covers only petroleum that may be profitably extracted by ordinary current methods of production under prices prevalent on January 1, 1936, the date of the estimate, and does not include an indeterminate quantity left in the ground by present producing methods, but recoverable by advanced methods of production, such as water-drive, under prices higher than those of 1935.

The data were obtained by the Institute's Special Committee on Production and Supply. Texas is shown to have the largest proven reserve, 5,500,000,000 bbl., California the second largest with 3,500,000,000 bbl., with Oklahoma ranking third with 1,200,000,000 barrels. Other states are as follows: Kansas, 400,000,000 bbl.; New Mexico (S. E.), 350,000,000 bbl.; Coastal Louisiana, 350,000,000 bbl.; Wyoming, 250,000,000 bbl.; Pennsylvania, 240,000,000 bbl.; Arkansas, 75,000,000 bbl.; Montana, 60,000,000 bbl.; Northern Louisiana, 55,000,000 bbl.; Michigan, 45,000,000 bbl.; New York, 40,000,000 bbl.; Kentucky, 35,000,000 bbl.; Illinois, 35,000,000 bbl.; Ohio, 30,000,000 bbl.; West Virginia, 25,000,000 bbl.; Colorado, 12,000,000 bbl.; and Indiana, 5,000,000 barrels.

Asks Appropriation to Fight "Hot Oil"

That the Federal Government intends to continue its assistance in the fight on "hot oil" was made apparent when the president's budget message to congress contained a recommendation for an appropriation of $350,000 for enforcement of the Connally law. The appropriation would be for the fiscal year beginning July 1, 1936. The current appropriation for enforcement during the year ending June 30, 1936, was $500,000, but it is understood that approximately $100,000 of this amount will be unexpended at the end of the year. The proposed appropriation is looked upon as being ample for enforcement purposes. The budget message did not request an appropriation for the Petroleum Administrative Board.

•

8,448 Wells Drilled in Texas in 1935

During 1935 a total of 8,448 producing wells were completed in the State of Texas, 7,956 being oil and 492 gas wells, an official report of the Railroad Commission reveals. The report further states that there were 12,561 applications to drill, 2,241 to shoot, 3,391 to plug, 1,530 dry holes, and 3,308 plugged.

December operations were slightly less than those of November, due to winter conditions. In December there were 855 applications to drill, 179 to shoot, 218 to plug, 546 producing wells, 111 dry holes, 287 plugged, and 57 gas wells.

•

Propose Crude Storage Survey Be Made

A committee of the Interstate Oil Compact Commission, whose representatives are from the states of Texas, Oklahoma, New Mexico, and Kansas, has made a proposal that the United States Bureau of Mines conduct a comprehensive survey of all crude petroleum now in storage throughout the country. The proposal was presented at a conference held in Washington between Bureau of Mines officials and commission representatives, the latter including E. M. Wells of New Mexico, E. O. Thompson of Texas, Tom Anglin and C. C. Brown of Oklahoma, and Homer Hoch and Marvin Lee of Kansas.

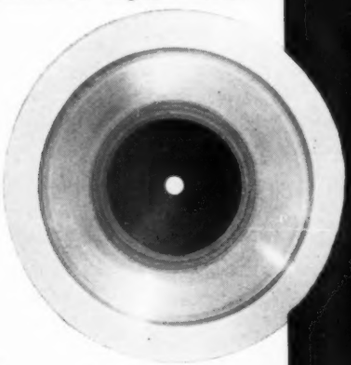
Approximately 300,000,000 bbl. of crude petroleum are now in storage in this country, the commission pointed out. The proposed survey would be for the purpose of analyzing this oil as to condition, kinds, grades, and possible uses. The "thiefing" analysis method would be employed, that is, samples taken from top, center, and bottom of all storage tanks. The purpose of the survey would be to make available to state regulatory bodies factual data that would assist in the administration and enforcement of state laws limiting production.

BAASH-R

Tr

"TRUBORE" DRILL COLLARS *give you these* ADVANTAGES . . .

- BALANCED, because the circulation hole is ACCURATELY centered.
- Smoothest rotation at all speeds.
- Full strength due to uniform wall thickness.
- Free passage for wire line core barrels, renewable cutters, surveying instruments.
- No internal eddy currents and sand cutting because the bore is SMOOTH.
- Available in all lengths to 55 feet; special diameters, bores and lengths to order.



"Trubore" DRILL COLLARS *Cost No More!*

Dead-on photograph of Baash-Ross "Trubore" Drill Collar shows how straight the circulation hole is, how uniform the wall thickness. Special machinery and methods of boring, developed by this Company during the past 5 years, are used to drill the hole straight and centered on the true axis of the drill collar. The regular shop inspection requires that a ten-foot test bar, only 1/8-inch smaller in diameter than the bore shall pass freely through.

BAASH-ROSS TOOL COMPANY

Cross section of Baash-Ross "Trubore" Drill Collar showing ten-foot test bar passing through circulation hole.

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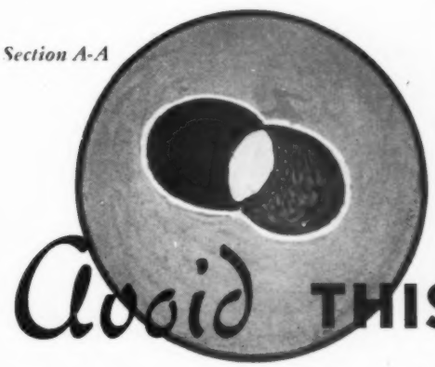
Inspect them yourself AT OUR HOUSTON AND OKLAHOMA CITY STORES!

Baash-Ross Trubore Drill Collars are the result of years of specialization, years spent in developing and perfecting equipment and methods for drilling the circulation hole straight and centered on the true axis of the drill collar. We believe that these drill collors are the truest that can be made and have given them the name "Trubore".

See these Baash-Ross Trubore Balanced Drill Collars at our Houston and Oklahoma City stores. They are ready for immediate delivery in lengths up to 55 feet. Inspect them carefully, note the care with which they are made, then specify them by the name "Trubore" — it is your assurance of uniform accuracy and highest quality.

Section A-A



Avoid THIS CONDITION *Specify*

Baash-Ross "TRUBORE" Drill Collars

An inaccurately drilled circulation hole results in unbalancing a drill collar by leaving a thicker body of metal on one side of the center than on the other, as shown in Section A-A. The enlarged area (B, in the cross-section) is caused by the misalignment of the two holes, which are ordinarily drilled from opposite ends toward the middle. In addition to weakening the drill collar, the shoulder frequently formed sets up eddy-currents in the circulation stream which cause sand cutting and further weakening at this point.

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PROGRESS OF MAJOR PIPE LINE WORK

AN 8-in. oil line from Rusk, Texas, to Conroe, a distance of 115 miles, was definitely assured recently when the American Liberty Pipe Line Company, Dallas, of which Dudley S. Golding is president, let a contract to the Fredell Construction Company of Houston for its construction. The American Liberty also announces the acquisition of the Liberty Pipe Line Company's 45.6-mile line from its field station on the Bridgewell-Palmer 88-acre tract in the R. E. Winn Survey in northern Rusk County to Rusk in Cherokee County. Already the American Liberty owns the Channel Transfer and Marketing Company line, a 35-mile, 8-in. outlet from Conroe to Houston. Thus, the completion of this project will give the American Liberty Pipe Line Company a continuous line from the East Texas field to the Gulf.

Construction work already is underway and the line is expected to be completed by March 15th. Three main line pumping stations will be erected and at Houston the terminals of the National Petroleum Company will be used.

In the East Texas field the American Liberty owns the International Pipe Line Company, the Golding-Murchison gathering system, and has effected an affiliation with the Associated Pipe Line Company of which J. F. Lucey and Ralph Fair of Dallas are the owners. The capacity of the new line will be 30,000 bbl. per day.

As stated, Golding is president of the American Liberty Pipe Line Company, with Clint W. Murchison and T. L. Wynne as vice-presidents, and D. R. Zachry as secretary-treasurer. Headquarters will be in Dallas.

●

Construction of a pipe line from East Texas to Baytown, Texas, by the Humble Pipe Line Company has been announced by officials of that organization. The line will be approximately 200 miles in length and will be an 8-in. carrier. It will be utilized for the transportation of natural gasoline, butanes, and propane from East Texas to the Humble Oil and Refining Company's refinery at Baytown where a polymerization plant will be added to the existing equipment.

The initial pump station will be near London, on a site adjoining the casinghead gasoline plant of the Humble in the East Texas field. The line will be all-welded and will follow the route of the company's oil lines via Groesbeck, Hearne, and Webster. Part of the pipe will be new, the remainder reconditioned stock.

At the outset the line will have a capacity of 9,000 bbl. daily, operating with one pumping station, later, however, it is planned that a station will be installed at Hearne increasing the capacity to 13,000 bbl., and later still two more stations will be added to the system to give the line an ultimate capacity of 17,000 barrels. One of these will be between London and Hearne, the other between Hearne and Webster. The line will operate as a closed system with centrifugal pumps. The cost of the new line and stations will approximate $1,000,000.

"The specific and immediate reason for construction of the line," says an announcement from headquarters of the Humble Pipe Line Company, "is in connection with a trade entered into between the Humble Oil and Refining Company, Humble Pipe Line Company, and Hanlon-Buchanan, Inc., whereby Humble Oil and Refining Company will purchase butanes and propanes from Hanlon-Buchanan, Inc., for polymerization at Baytown, where a polymerization plant will be built during the coming year and operate on such butanes and propanes, and also that produced by Humble Oil and Refining Company at its casinghead plant in East Texas and elsewhere, and from the gasoline extraction plant at its Baytown refinery."

The Oklahoma Contracting Company of Dallas, Texas, has been given a contract for laying a part of the line, and the remainder will be constructed by engineers and construction crews of the Humble Pipe Line Company.

●

Pipe is reported already bought for construction of a crude oil carrier to extend from the East Texas field to Texas City, Texas, a distance of 200 miles. The Republic Oil Refining Company will be the builders of the 8-in. line which will have its terminus at that company's refinery, according to the report. Including stations, the cost of the line will be approximately $1,500,000, it is estimated, and, in addition, the Republic will spend $500,000 to increase by 5000 bbl. daily the capacity of its refinery.

●

A 6-in. gasoline line to run from the East Texas field to the Gulf Coast, 200 miles, is reported as being planned by a group of East Texas refiners and independent producers, among whom are mentioned John Gilliland and Rhea Starnes. Confirmation of this project has not been obtained, but, if constructed, the line will involve an expenditure of approximately $1,250,000, it is said.

●

With the Rodessa field of North Louisiana daily increasing in size additional pipe line outlets are being provided. The Gulf Pipe Line Company has completed an 18-mile 6-in. line from the Potter Point pumping station to the field. The Rodessa Oil and Refining Company has made a survey and it is reported that that company will construct a 40-mile line from the field to its Cedar Grove, Louisiana, plant (the old Crystal Oil Company refinery). Work is supposed to begin in January on this project. The Arkansas-Louisiana Gas Company has appropriated funds for an 8-in. carrier from the Caddo field to the Rodessa field, approximately 14 miles.

●

The Lea County area of southeastern New Mexico is to have two new pipe line outlets. The Gulf Pipe Line Company will lay 65 miles of 8-in. from the Hendrick pool of Winkler county, Texas, north to the Hobbs field. It will run to the east of the Cooper, Eunice, and Monument pools and will tap arteries serving producing properties of the Gypsy Oil Company in those areas.

The Shell Pipe Line Company is to construct 40 miles of 10-in. line extending from the Hendrick pool to the Cooper and Eunice pools. At Eunice it will connect with an existing system from Hobbs to Eunice.

BIRTHDAY OF A FAMOUS CONQUEROR

FIG. 1740—GASO Duplex Piston Pump. Gasoline Engine Drive—84 to 258 Bbls.

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A very old man, Father Time—but still a relentless conqueror.

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for every oil industry need

LATEST ACTIVITIES IN THE OIL FIELDS

NEVILLE G. PENROSE and the Rowan Drilling Company have found oil with their wildcat test, No. 1 Will Cary, in Lea County, New Mexico. The well has been estimated as good for 600 to 700 bbl. of crude per day. It is drilled to a total depth of 3555 ft., with casing set and cemented at 3372 feet. The well is approximately three miles east of the Skelly Oil Company's No. 1 Henderson, which opened an area recently that is now being tested in three directions by drilling operations.

●

A new pool has been indicated for Jack County, Texas. Oil Industries, Inc., recently brought in their No. 1 S. J. Beasley, three miles east of Bryson, producing 300 bbl. of oil an hour. The well is drilled to a total depth of 3003 feet.

●

First production for St. Mary Parish, Louisiana, has been found by the Herton Oil Company with its No. 1 Roane. After being plugged back to 7498 ft. from 7512 ft., the well made 25 bbl. of 41.6 gravity oil per hour through ¼-in. choke. Tubing pressure was 1190 lb., and casing pressure 1175 pounds.

●

The successful completion of the Mid-American Oil Company's No. 3 Government test gives the Sheep Creek structure of Fremont County, Wyoming, its second producing well. It was brought in as a pumper, making 250 bbl. of oil a day at a total depth of 2390 ft. in the Embar lime. The second well is considerably larger than No. 2 Government, the field opener.

●

A new Texas Gulf Coast oil field apparently has been discovered, The Texas Company's Pierce Estate C-1 in Wharton County having a showing of oil on drill stem tests. Producing formation is the Frio. The test was drilled to 7244 ft. and plugged back to 5200 feet. This will be the fourth pool for Wharton County if the well proves to be a commercial producer.

●

In the old Deer Creek pool of eastern Grant County, Oklahoma, the Argo Oil Company has completed a deepening operation that may prove of considerable importance. The company's No. 3 Stewart, which had been producing from the Wilcox at a total depth of 3990 ft. until its production had dropped to a level where it was no longer profitable to pump, was deepened to 4260 ft. in the Arbuckle lime and began to produce at the rate of 86 bbl. per hour. The results of this operation are expected to cause a general deepening of wells in the area.

●

The Union Oil Company broke all existing records recently when it landed and cemented 10,813 ft. of 6⅝-in. casing in its No. 1 Lillis-Welch in the western end of the Kettleman North Dome field of California. The string also is said to be the heaviest ever landed and cemented. The operation took 15 hours, and 200 sacks of cement were required.

●

The Columbian Carbon Company has brought in a gas well in the Elk district of Kanawha County, West Virginia, that is the largest Oriskany sand gas well ever to be completed in the lower eastern fields. It is on the Little Sandy Creek and gauges 8,125,000 cu. ft. per day. The total depth of the hole is 4931 feet.

●

An intensive drilling campaign may result from the successful completion of the Shell Petroleum Corporation's No. 1 Lee in Reno County, Kansas. The well, in the new Reece pool, is reported to be the largest Viola lime well completed west of the Granite Ridge in the state. Drilled to a total depth of 4158 ft. the well flowed 2910 bbl. of oil naturally on a 20-hour potential test.

AVERAGE CRUDE PRICES

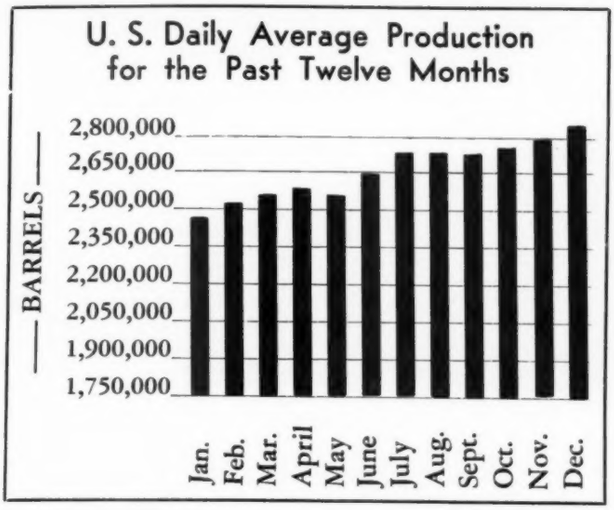
California	
Kettleman Hills	$ .91-$1.11
Playa Del Rey	.87
Coalinga	.76
Signal Hill	.86
Montana	1.45
Wyoming	1.10
Colorado	1.00-1.10
New Mexico	.75-.95
Texas	
North Central	.84-1.08
Panhandle	.81-.98
West Texas	.75-.95
Gulf Coast	.85-1.30
Darst Creek	.88-1.22
East Texas	1.15
Kansas	1.10
Oklahoma	1.10
Arkansas	.75-.80
Louisiana	
North Louisiana	$ .86-$1.10
Gulf Coast	.82-1.22
Illinois	1.23
Kentucky	1.23
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.12
Pennsylvania	
Bradford	2.30
Southwest	2.02
Eureka	1.97
Buckeye	1.82
Corning	1.32
West Virginia	1.67
Canada	2.10-2.17

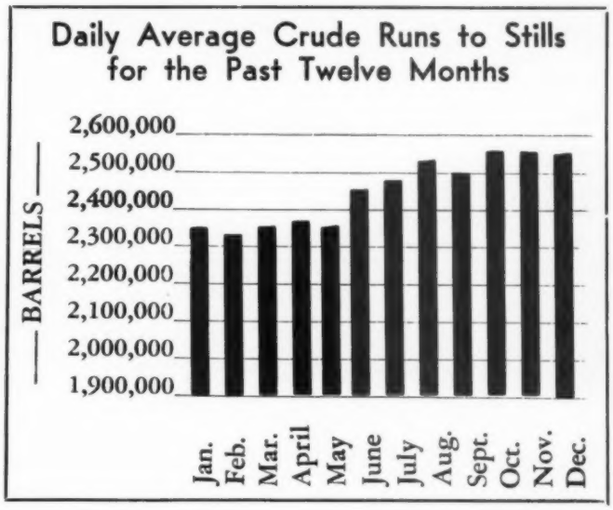
DAILY AVERAGE CRUDE OIL PRODUCTION

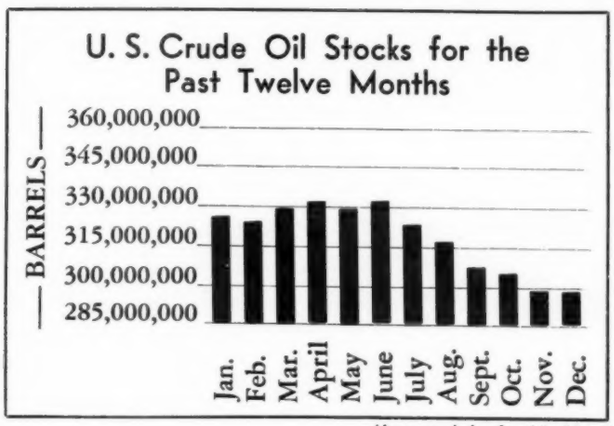
Furnished by A.P.I.

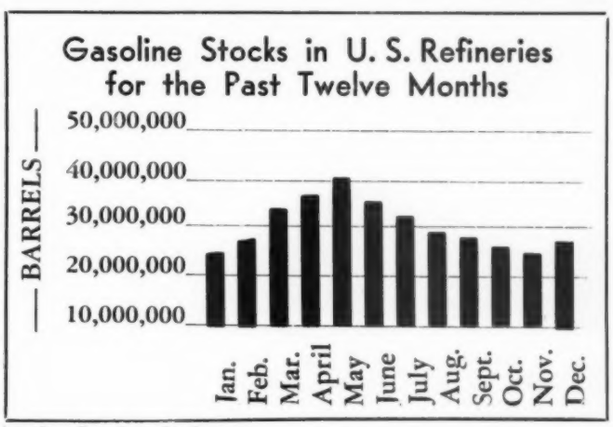
(Figures in Barrels)

	B. of M. Dept. of Interior Calculations (January)	Week Ended Jan. 4 1936	Week Ended Nov. 30 1935	Week Ended Jan. 5 1935
Oklahoma	481,000	462,800	484,700	407,000
Kansas	134,000	137,300	145,800	137,550
Panhandle Texas	.....	59,350	67,100	55,900
North Texas	.....	56,700	59,800	57,500
West Central Texas	.....	25,400	25,650	26,400
West Texas	.....	160,050	165,250	155,700
East Central Texas	.....	49,250	45,400	51,650
East Texas	.....	438,700	434,000	420,700
Southwest Texas	.....	66,150	64,050	55,400
Coastal Texas	.....	212,700	206,700	173,300
TOTAL TEXAS	1,017,200	1,068,300	1,067,950	996,550
North Louisiana	.....	43,250	34,550	24,000
Coastal Louisiana	.....	125,650	126,700	84,450
TOTAL LOUISIANA	132,600	168,900	161,250	108,450
Arkansas	28,900	29,500	29,700	33,600
Eastern	98,000	106,350	104,700	106,150
Michigan	42,200	45,700	49,650	28,550
Wyoming	33,200	37,450	36,550	34,950
Montana	11,300	12,550	13,150	11,900
Colorado	3,700	3,900	4,150	3,050
New Mexico	59,300	58,800	57,850	44,750
TOTAL EAST OF CALIF.	2,041,400	2,131,550	2,155,450	1,912,500
California	517,800	671,200	665,000	476,100
TOTAL UNITED STATES	2,559,200	2,802,750	2,820,450	2,388,600









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for December, 1935

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	229	226	90	125	3600	2	40	Rotary
Duval County	61	57	13	25	2300	2	22	Rotary
Archer County	32	15	15	26	660–1800	1 or 2	40	Rot.-Cab.
Conroe	2	1	1	1	2000–7400	3 or 4	40	Rotary
Panhandle	61	57	35	147	2200–3900	2	40	Rotary
Refugio County	6	5	2	3	5200	2	38	Rotary
Oklahoma								
Oklahoma City	9	9	4	43	6500	3	39	Rotary
Pontotoc County	46	42	11	65	1800–4488	2 or 3	38	Rotary
Osage County	23	19	12	44	380–2850	2	37.5–40	Rot.-Cab.
Kansas								
McPherson County	2	0	2	5	2900–4300	2	38	Rot.-Cab.
Harvey County	2	2	1	2	3450	2 or 4	37	Rot.-Cab.
Ellsworth Arch	47	36	18	104	3300	4	37	Rot.-Cab.
California								
Kettleman Hills	1	1	8	28	8300	3 or 4	40	Rotary
Long Beach	3	3	6	32	7000	3	36	Rotary

Field Activities by States for December, 1935

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1934 (In Barrels)
	December	November	December	November	December	November	December	November	December	November	
Arkansas	6	7	2	1	13	8	13	12	34	33	11,412,100
California	55	50	45	46	75	78	85	97	229	233	175,678,362
Colorado	1	1	1	1	....	....	2	2	29	28	1,168,000
Illinois	....	5	....	2	....	....	19	20	10	8	4,466,000
Indiana	....	3	....	1	....	....	2	4	56	52	813,000
Kansas	92	89	63	60	114	125	35	34	224	221	45,577,050
Kentucky	12	13	7	8	....	....	13	3	16	6	4,863,000
Louisiana	65	48	53	33	55	63	31	44	146	141	32,572,900
Michigan	57	62	40	42	37	83	90	92	95	124	10,589,600
Mississippi	1	....	0	....	....	....	1	2	10	8	Gas. Prod.
Montana	16	20	12	16	....	....	8	7	47	66	3,797,000
New Mexico	33	27	26	23	....	....	12	13	99	103	16,529,050
New York	....	....	....	....	....	....	4	1	4	8	3,880,700
Ohio	176	119	126	80	....	....	38	35	151	135	4,291,000
Oklahoma	211	166	155	106	192	241	64	93	511	527	176,506,550
Pennsylvania	9	9	5	5	....	....	20	26	97	103	15,353,850
Texas	803	846	604	632	659	2184	295	337	887	1037	380,848,000
West Virginia	25	44	17	36	....	....	19	23	109	81	4,043,550
Wyoming	8	7	7	7	....	....	7	6	59	73	12,371,100
Totals	1570	1515	1163	1099	1173	2782	758	843	2813	2991	903,350,812

THE MONTH'S ACTIVITIES IN REFINING

Percent Refinery Capacity Operated

Western Division, 58.0 percent **Central Division, 65.4 percent** **Eastern Division, 69.9 percent**

THE Atlantic Refining Company will construct a $3,000,000 refinery at Atreco, Texas, on the Neches River, ten miles south of Beaumont, where the Atlantic has its pipe line terminal. The announcement was made by W. M. Irish, president of the company, at Philadelphia, Pennsylvania, who said construction would commence as soon as engineering plans are completed.

The plant will include a gas polymerization unit of the thermal type having a daily capacity of 1200 bbl., and a combination skimming and cracking unit capable of handling 20,000 bbl. of crude daily.

The M. W. Kellogg Company will have charge of construction.

●

The Petrotex Company will construct a Donnelly cracking unit at its Texas City, Texas, refinery. The new unit will have a daily capacity of 5000 bbl., and has been designed by the Mid-Continent Engineering Corporation of Dallas. It will be completed in April. The Petrotex Company is headed by Marion Travis, who also is president of the Independent Terminal Company, Texas City.

●

The Phoenx Refining Company, Inc., of San Antonio, Texas, is erecting a $20,000 refinery with a daily capacity of 1000 bbl. of crude at Chalmers. It is expected to be in operation within a few weeks. Raymond Russell is president of the company. Crude supply will be from the Skelly-Bay City field.

●

McClanahan Refineries, Inc., has started construction of a Dubbs reforming unit in its refinery at St. Louis, Michigan. The unit, which will have a charging capacity of 1250 bbl. a day, will include absorber and stabilizer and caustic and doctor treating plant. It is designed with oversize parts to facilitate future addition of a two-coil Dubbs cracking unit. Arthur G. McKee & Company, of Cleveland, is the contractor.

The refinery at present has a 1600 bbl. daily crude distillation unit that is being enlarged to handle approximately 3000 barrels.

The refinery is supplied with crude from the Crystal field by the McClanahan Oil Company through a 4-in. pipe line operated by the McClanahan Pipe Line Company.

●

Cosden Oil Corporation recently signed a license agreement with Universal Oil Products Company of Chicago, and will remodel its Winkler-Koch cracking unit into a 7000-bbl. a day Dubbs cracking unit. The unit is in the Cosden refinery at Big Spring, Texas.

The license contract was signed by W. D. Richardson, temporary trustee of the Cosden corporation, and was authorized by Judge J. C. Wilson of the Federal District Court of Northern Texas, sitting in Fort Worth.

At the same time, the court ordered the trustee to cancel a license taken by the Cosden corporation from the Donnelly Process Corporation to cover the operation of the Winkler-Koch cracking unit, and to discontinue the use of the Donnelly process.

A third step authorized by Judge Wilson was the settlement of two suits brought against the Cosden interests by Universal Oil Products Company, charging infringement of cracking patents.

J. S. Cosden, president of the Cosden Oil Corporation, has been a noted figure in the oil industry since the beginning of refining in the Mid-Continent field. He built up and for some years headed the refining company which is now the Mid-Continent Petroleum Company in Tulsa, Oklahoma.

●

The Pure Oil Company has erected at its Muskogee, Oklahoma, refinery a 160-ton fractionating tower, 110-ft. long and 12-ft. in diameter. The tower is a new unit used in obtaining eight products from a single process. It was constructed by the Alco Products Company.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending January 4, 1936

A. P. I. Figures

(Figures in Barrels of 42 Gallons Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	453,000	74.0	12,774	9,129
Appalachian	94.8	87,000	59.6	2,027	868
Ind., Ill., Ky.	95.9	323,000	76.2	8,323	3,792
Okla., Kans., Mo.	84.8	249,000	64.8	5,267	4,472
Inland Texas	48.5	75,000	46.9	1,165	1,513
Texas Gulf	96.8	591,000	89.8	4,916	10,533
La. Gulf	96.4	103,000	63.2	1,179	4,291
No. La.-Ark.	90.0	45,000	62.5	276	626
Rocky Mt.	61.9	32,000	53.3	880	764
California	92.6	495,000	62.7	10,481	68,194
TOTALS WEEK:					
Jan. 4, 1936	89.6	2,453,000	70.7	47,288	104,182
Dec. 28, 1935	89.6	2,600,000	75.0	46,472	105,053

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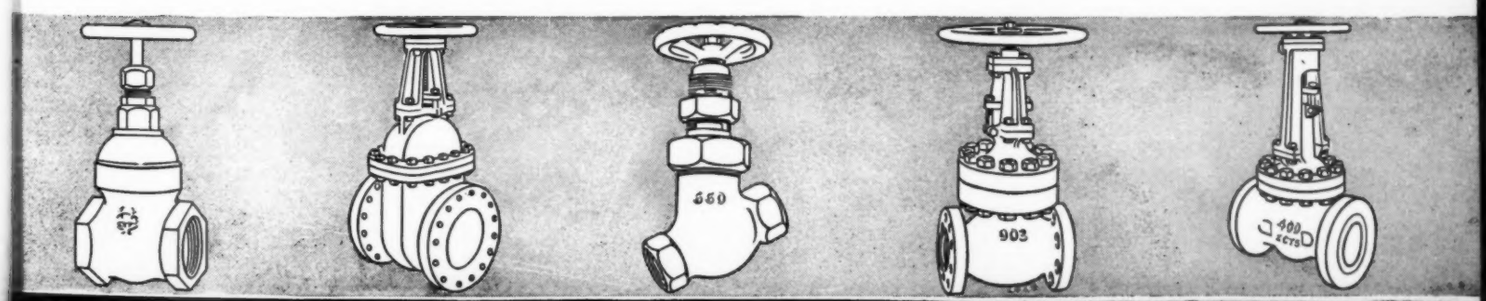

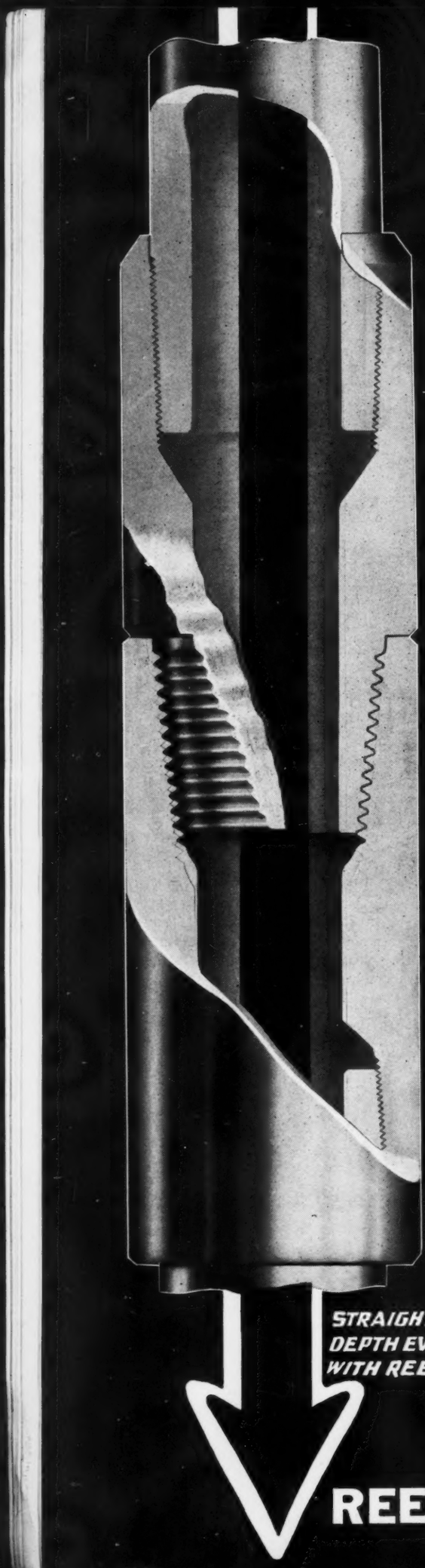

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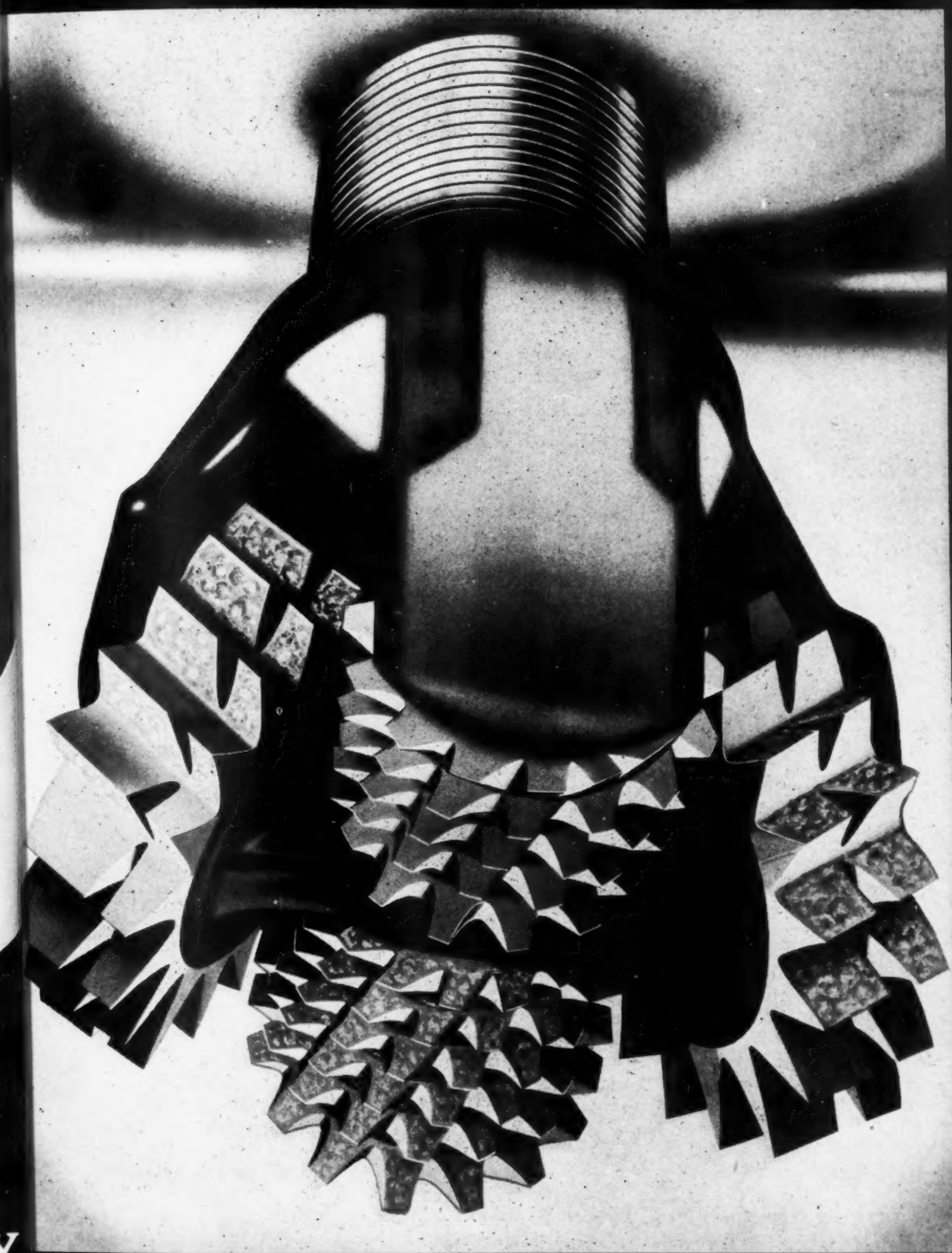

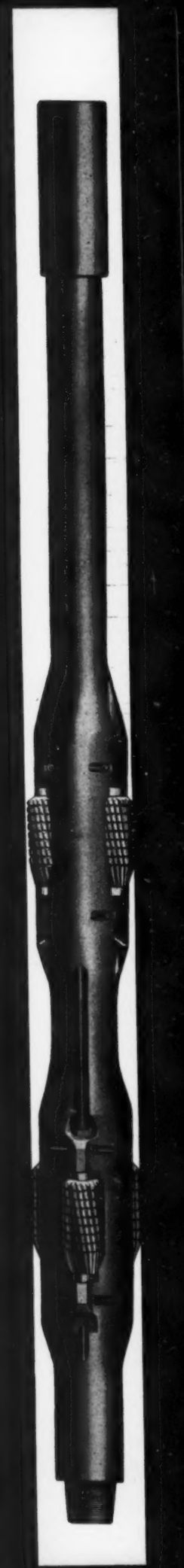

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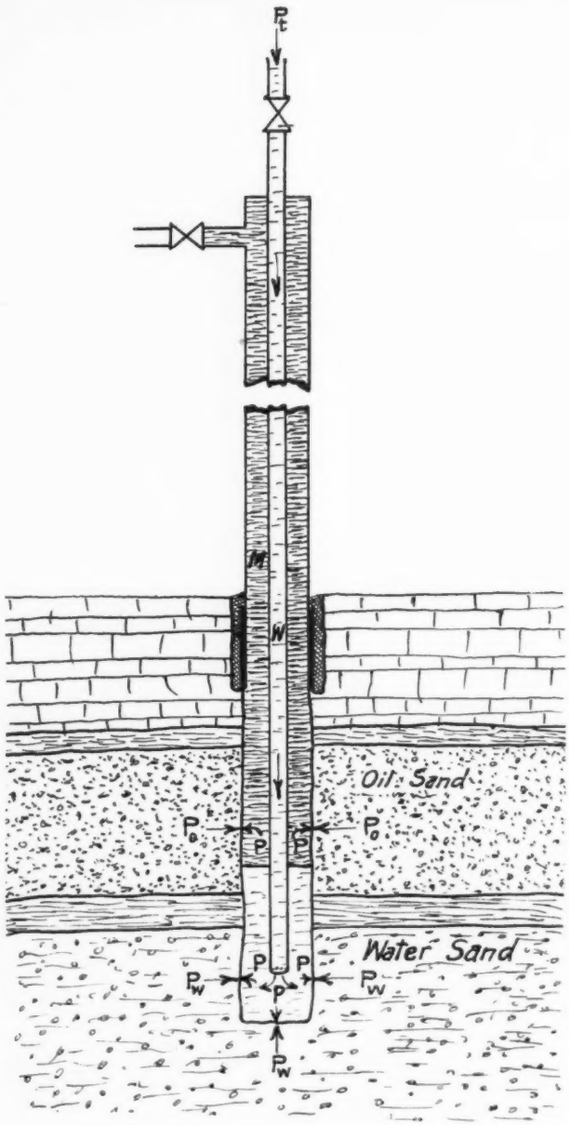


Fig. 1. With mud between tubing and casing and the well closed at the casinghead, water is pumped down through the tubing into the water sand. Pressure P_t is controlled so that P is greater than pressure P_w but less than pressure P_o

Injection Proc Water

By

K. C. SCLATER

THE orthodox method of shutting off bottom water in an oil or gas well is that of placing a plug of neat cement in the bottom of the hole. Though the details of the method employed in placing the cement may vary in different wells, the efficacy of all shut-offs of this type depends on the bond between the cement plug and the wall of the hole. Slight shrinkage in the setting or drying of the cement may result in seepage of the water up between the wall of the hole and the plug. Thus it is often difficult to get a bottom water shut-off that is permanent and satisfactory. Evidence of this is the number of failures that are encountered in this type of shut-off.

It was after numerous such failures to shut off a bottom water sand in the Conroe field that led to the development of the process that is the subject of this article, that of injecting a thin slurry of cement into water-bearing sands in oil or gas wells to shut off water.

Though this process may not be applicable to all types of water shut-off and its efficacy may be questioned by those who are guided largely by results in the laboratory, the fact remains that it has been tried and found successful. The method in brief consists of loading the well up with heavy mud fluid, then displacing some of the mud in the bottom of the hole with clear water, tubing being set close to the bottom of the hole. With the casinghead closed and a column of mud in the annular space between the tubing and casing, water is then pumped under pressure into the water-bearing sand. After the water sand has been thoroughly flushed, the water is followed up by a thin slurry of cement, which also is pumped under pressure into the water sand. Sufficient slurry is injected to reach out in a radial direction far enough to insure all the pore spaces in the sand in the vicinity of the well bore being filled with cement. The cement is then followed up with heavy mud to clear the tubing of cement, after which the tubing is raised a few feet and the cement allowed to set. When the cement hardens it becomes an integral part of the water sand and forms an effective seal against entering the hole.

The simple theory underlying the process is that an oil sand resists the injection of water to a much greater degree than a water sand.

It was only after numerous field observations of the difference between water sands and oil sands in wells in their ability to take water, that the possibilities and practical value of the process suggested itself to E. O. Buck, chairman of the engineering committee of the Conroe Operators' Association. Operators in that field were confronted with serious water problems in their wells. Buck was given an opportunity to try out his process on a well in the Conroe field that had been flooded with salt water and had been dead for several months. No more difficult type of well could have been used for the experiment.

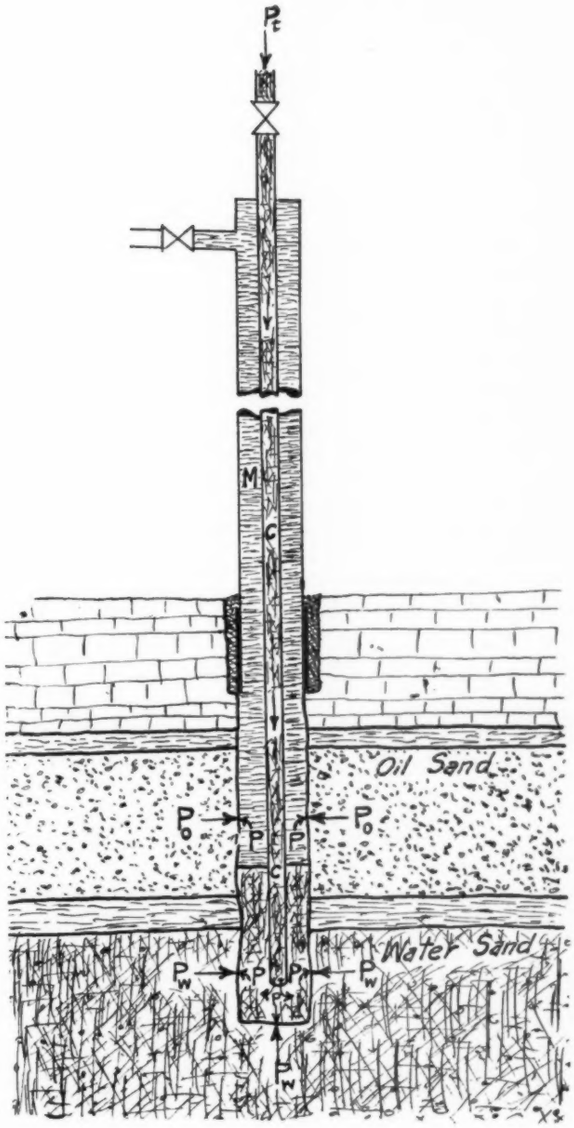
No special equipment was acquired for the job; but enough data had been assembled with regard to pressures and volumes to ensure that the water sand would be pumped full of cement for a distance of several feet around the well bore.

First of all, about 30 barrels of water were pumped in to displace the mud in the bottom of the hole, after which the valve on the casing was closed. Water was then pumped down through tubing and into the water sand for about an hour in order to flush the sand clean. During the time the water was being pumped in the pressure was carefully regulated. By referring to Fig. 1, the pressure at which the water sand begins to take water is shown as P_w, and the pressure at which the oil sand begins to take water as P_o. According to Buck's observations in the East Texas field, and also in the

Fig. 2. After water sand is thoroughly flushed, the water is chased by a thin slurry of cement and injected under pressure into the water sand, pressure P_t being still controlled so that P is greater than pressure P_w but less than pressure P_o

c ess For Sealing r Sands

Thin slurry of cement injected into water sands is successful in shutting off water in oil and gas wells—process may have wide application



Conroe field, he found that when wells were being killed the average resistance of an oil sand to injection of water to be approximately twice that of a water sand; that is to say, pressure P_o was twice as great as pressure P_w. (See Fig. 1).

This information served as a guide in the regulation of the pressure while pumping the water and the cement.

While the water was being pumped the cement slurry was carefully and thoroughly mixed to a consistency of 13 lb. per gallon. After thorough flushing of the sand the water was immediately followed up with cement slurry. One hundred sacks of cement were thus pumped without interruption into the water sand in the form of a thin slurry. This was followed by sufficient heavy mud to clean the tubing of cement, after which the well was closed in. The tubing was first raised a few feet and then the cement allowed to set under pressure for 72 hours.

Careful measurements were made of the water, slurry, and mud pumped into the well. The top of the cement plug was placed within six ft. of the point determined on.

The original plans made in placing the cement called for leaving 11 sacks of cement in the hole, and it is estimated that approximately 15 sacks were left in the hole. This discrepancy, not a serious one considering the nature of the experiment, probably was due to the irregularity of the open hole below the casing.

After allowing the cement to set 72 hours, screen was re-run to the top of the plug, and the well brought in by swabbing.

Salt water was produced with the oil for three days after the well came back to life; but the water-oil ratio gradually decreased, and at the end of the third day, pipe line oil was being produced.

Shortly thereafter, the well had been flowed at a rate of as high as 50 bbl. an hour through a ½-in. choke without a trace of salt water. This was evidence that the water sand was sealed off, and that it is possible to pump thin cement slurry into a water sand under pressure without any apparent damage to the overlying oil sand exposed in the hole.

Two other shut-off jobs in wells where this process was used were successfully completed in another field in the Gulf Coast in which the sand conditions were entirely different. In one of these wells the pay sand was a virgin formation that had never been produced. The cement was injected after a drill stem test had been made that showed salt water and oil. On those wells 200 sacks and 170 sacks of cement, respectively, were used. The slurry was injected into the water-bearing sand without any apparent damage to the oil sand.

The real value of this method of shutting-off water lies in the fact that it is simple to control, requires no elaborate equipment and, except for exercising care in regulating the pumping pressure, does not differ from an ordinary cementing operation.

Salt water in oil fields has always been a menace to production, and particularly so in flowing wells. It is rarely that salt water is entirely absent. In many fields today salt water has encroached and flooded out the oil. A salt-water drive when controlled can be a great help in producing oil.

If not controlled, sooner or later the water will flood the oil horizons and eventually make commercial production impossible. Sometimes the only means of obtaining oil is to produce salt water with it. This means a greatly increased lifting cost, besides the problem of disposal of salt water at the surface after it is produced. This latter angle alone is an ever-present problem in many fields. Kansas and Oklahoma in particular have been fighting this problem for many years and slow progress has been made in overcoming it. Besides the cost of water disposal there are the losses sustained due to trapping of the oil in the sand, and also the expense of repairing and replacing corroded equipment. The problem of salt water shut-off, therefore, assumes an importance that gives to the method of shutting off water here described some significance.

It has been the common practice since the beginning of the industry to attempt to exclude water movement in the oil sands before they have become depleted and many an ingenious device has been tried. Notable progress in the methods of using cement in wells brought about its application as an agent to plug off bottom water. Everyone is familiar with the common practice of placing cement plugs in the bottom of wells and relatively small percentage of really successful completions by this method. In soft sands and thick sand bodies a high percentage of failures in shutting off bottom water is common.

Special cements and methods of placing it have been tried in wide variety; few of these have been universally successful and most of them have proved to be only temporary remedial measures. In the process here described the results appear to have been quite successful. With more experience in technique it promises to be a valuable alternative in plugging off salt water in refractory wells.

Essentially the process consists of forcing large quantities of cement deep into the water sands and leaving the oil sands free from cement and water contamination.

It is to be noted that the experiment was conducted on the well in the Conroe field only after the well had been dead from salt water for several months and all attempts to rejuvenate it by injecting oil and gas were of no avail.

It is not implied here that this method is a panacea for the ills of water encroachment. Unquestionably there are many wells that cannot be successfully reconditioned. A large majority of wells now producing salt water undoubtedly could be reworked and the water successfully plugged off if the necessary care were exercised.

Many fields producing oil from several horizons experience salt water encroachment in the upper or intermediate sands before the lower horizon. In such instances good producing horizons had to be cemented off by employing the old methods of shut-off. It is believed that many failures of this kind can be eliminated by applying this new process of cementing.

Buck, who now has used the process successfully on numerous wells, is confident that light cement slurry can be forced into any sand that produces salt water regardless of its position relative to the well bore without damaging the oil-saturated sands in the least. Further experimental tests with the process are in progress, but at present it seems that it will be possible to correct any well making salt water that still has an oil-saturated sand left to produce oil.

During the course of drilling a well it now is possible by means of electrical logs to detect the water-bearing sands encountered. In such cases it should be quite feasible to plug off these water sands by means of the injection process as they are encountered in drilling. Whether the process would be applicable in water-bearing limestone formations, or even where only the producing horizon is limestone will of course depend on the factor of permeability.

In Fig. 2 is shown the process of injecting the slurry into an underlying water sand, and in Fig. 3, into an intermediate water sand. The pressure symbols P_t, P_o, and P_w have the same significance as those in Fig. 1. Just what the limitations of the process are still remains to be seen. In certain cases no doubt the differential pressure between P_o and P_w would prohibit its use.

The results already obtained by employing this process seem to warrant it a place in oil well cementing practice.

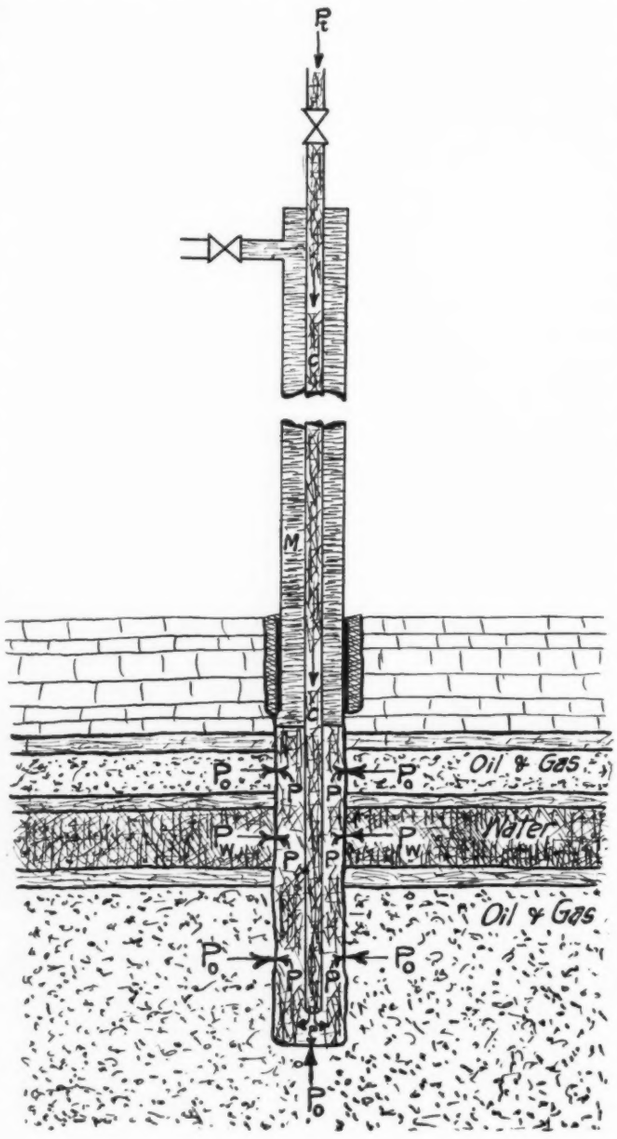
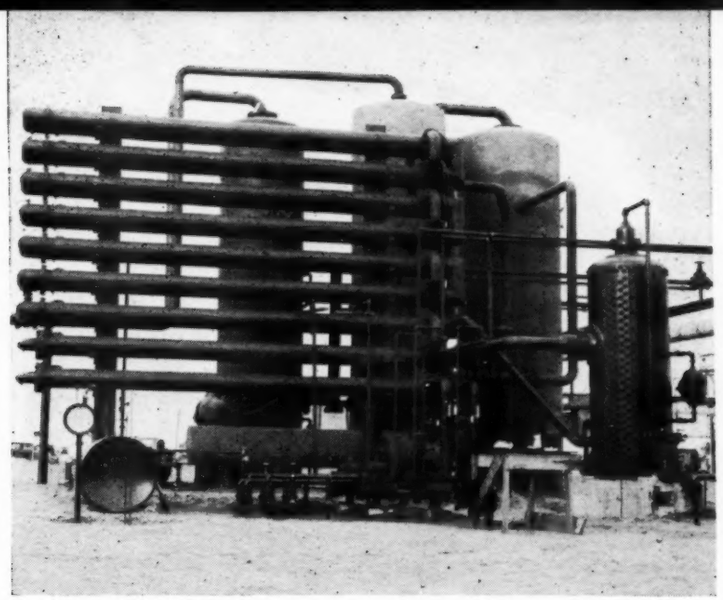


Fig. 3. Sealing an intermediate water sand by flushing with water and injecting a thin slurry of cement. The pressure P_t is regulated so that P is greater than pressure P_w but less than pressure P_o



Distillation unit

High-Pressure Absorption-Type Natural Gasoline Plant in Operation on Main Gas Line

Lone Star Gas Company completes unit at Trinidad, Texas, with capacity of 100,000,000 cu. ft. gas daily

By FRANK H. LOVE

AT Trinidad, Texas, the Lone Star Gas Company has completed and, on January 1st, placed in operation a high-pressure, absorption-type natural gasoline plant that, with respect to its capacity, is one of the largest of its kind in the State of Texas, being capable of handling 100,000,000 cu. ft. of gas daily, although to date the volume has been approximately 25,000,000 cu. ft. The fact that the gas, coming from the Cayuga field of Anderson County, and a little later also from the Long Lake field in the same county, is low in gasoline content prevents the plant's output from reaching a figure commensurate with some of the other large plants of the state. Approximately 0.4 gal. of finished product is being obtained from each 1000 cu. ft. of gas.

The plant is on the 20-in. trunk line extending from the Long Lake and Cayuga fields to Irving, Texas, construction of which was started several months ago and now nearing completion. A short stretch between Cayuga and Long Lake yet remains incomplete. At present gas is being received entirely from the Cayuga field, but Long Lake wells will be connected as soon as the line is finished.

Lone Star engineers and construction crews were in charge of erecting the plant at Trinidad, functioning under the supervision of E. F. Schmidt, general superintendent of the Lone Star Gas Company, J. R. Jarvis, superintendent of gasoline plants, P. C. Coffin, assistant superintendent of gasoline plants, and Julian L. Foster, chief engineer. John Kindle, transferred from Ranger, Texas, was field superintendent of construction forces and is now in charge of plant operations.

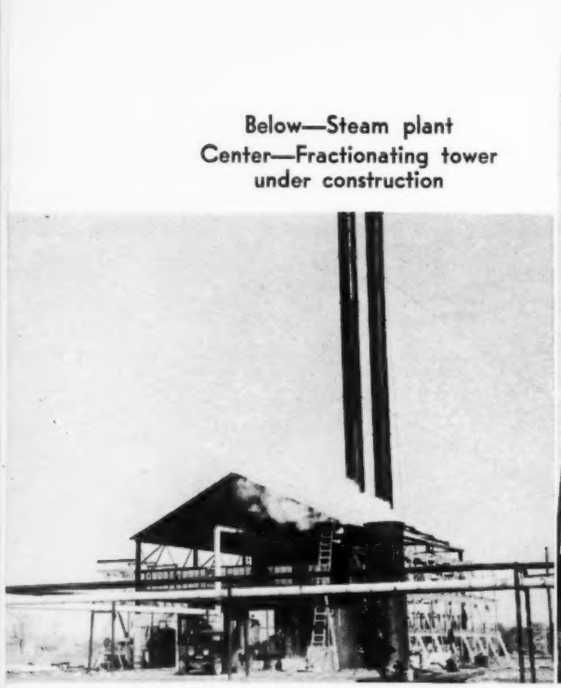
In designing the plant particular attention was given, in addition to observing those factors necessary for efficient operation, to the spacing and placing of units in a manner to provide the greatest degree of safety. Gasoline pumps and vapor compressors, the equipment handling the most inflammable materials, are situated at the opposite end of the grounds from the boiler room where the only fire exists. Check valves and non-return valves have been provided, and guard rails and gratings installed where needed. In addition, effective fire-fighting equipment has been made an important part of the plant's appointments.

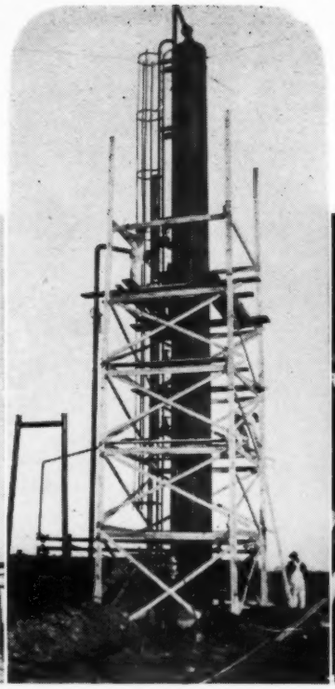
Gas is received under its own pressure, bottom-hole pressure at Cayuga being approximately 1565-70 pounds. After being metered it is taken at the battery of four bubble-type absorbers and washed with mineral seal oil. The absorbers operate on a pressure of 300 to 400 pounds. A scrubber has been installed only on the outlet header, to catch any mineral seal oil that may be present with the gas after it has passed through the plant, it not being necessary to employ an inlet scrubber with the type of gas handled.

The distillation unit has two stills, 18 heat exchangers, and a dephlegmator, one still operating at 60 lb. pressure, the other at 35 pounds. The latest type temperature controls and recorders have been provided. The fractionating tower, through which the gasoline passes for final treatment, is of the bubble-type, three ft. in diameter, 49 ft. in height, and contains 30 trays. This unit also is equipped with temperature controls and recorders.

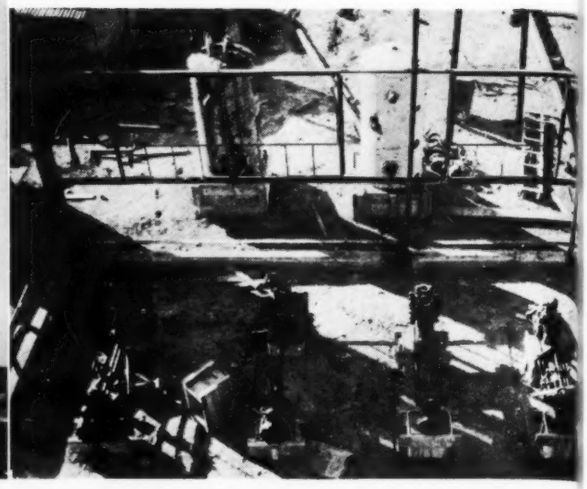
Pumping equipment consists of two steam-driven reciprocating pumps, 12-in. by 5½-in. by 12-in., for handling the lean mineral seal oil; two water pumps, turbine-driven centrifugals, each having a capacity of 1000 gal. per minute; and five reciprocating close-clearance pumps capable of handling extremely light gasoline. Three of these are 8-in. by 4-in. by

Below—Steam plant
Center—Fractionating tower under construction





Below—Birdseye view of group of gasoline pumps



12-in., and two 6½-in. by 3-in. by 8-inch. Pumping from storage to the loading rack is accomplished by means of a 10-in. by 6-in. by 10-in. duplex reciprocating unit.

The vapor compressors are 170-hp. units, two in number, all vapors being two-staged. Power pistons have a 20-in. stroke and 18-in. bore, while on the compression end they are 10-in. by 20-in. on the low stage side and 6-in. by 20-in. on the high stage.

A 12-bay cooling tower, 80 ft. long by 25 ft. wide by 37 ft. high, is of the latest design, its special feature being reduction in the loss of water. Oil coolers and gasoline condensers of the open type are set in the base of the tower. Water supply for cooling, as well as other purposes, is obtained from two wells dug in the plant's grounds, and requires but slight treatment for hardness.

Steam is provided by two 258-hp. water tube boilers. A feature of the steam plant is an atmospheric combination condenser and feed water heater.

Electric power for the plant is supplied by a 10-kw. generator driven by a small steam engine. Storage capacity for the finished gasoline totals 300,000 gal., consisting of eleven 10-ft. by 40-ft., and five 10-ft. by 30-ft. horizontal tanks.

The product of the plant, a 26-70 blending gasoline, is being marketed to refineries and shipped by rail. A 10-car loading rack has been constructed for this purpose, and 8000 ft. of spur track laid. Vapor-tight dome covers are used on loading cars for collecting vapors, which are returned to the plant for recompression.

Buildings housing the various units are constructed of steel framework and covered with corrugated asbestos lumber. Five company houses are nearing completion for occupancy by the plant superintendent and operators.

While the plant at present is operating entirely on Cayuga gas, as mentioned, it will be a short time only until Long Lake wells are added. Connections have been made to 22 wells at Cayuga, some of which are gas wells and some combination oil and gas. Eight gas wells and two oil wells will be connected at Long Lake. Negotiations are underway for additional wells that soon are expected to form a part of the gas supply. Cayuga is but ten miles from the gasoline plant and Long Lake 15 miles. After the gas is cleaned it is transmitted through the Lone Star's new 20-in. carrier, connecting with the company's pipe line system near Dallas. The gas is being blended with other gas in the system for domestic and commercial use. Bottom-hole pressure on the wells is sufficient not only to carry the gas to the plant but also to transport it to its final destination without the aid of booster stations. At Cayuga the pressure is 1565-70 lb., and at Long Lake 2100 pounds. Wells in the latter field are producing from the Woodbine at an approximate total depth of 5150 ft., while in the former production is from the Woodbine also but at a shallower depth, 4200-4400 feet.

Inasmuch as the plant has been in operation but a short time no analysis is available of the mixed gas received; however, there are numerous analyses made from samples taken at the wells prior to the time they were tied into the line. An analysis of gas from typical well in the Cayuga field shows the following:

Component	*Mol Weight Percent*
Methane	91.3
Ethane	3.75
Propane	2.12
Iso-Butane	.71
Butanes	.85
Pentanes plus	1.27
	100.00

A mixed sample of gas taken from two representative wells in the Long Lake field upon analysis was found to contain the following components:

Component	*Mol Weight Percent*
Methane	96.88
Ethane	1.63
Propane	.62
Iso-Butane	.0
Butanes	.87
Pentanes plus	.0
	100.00

This latter gas, by the charcoal test, was found to have a gasoline content of .160.

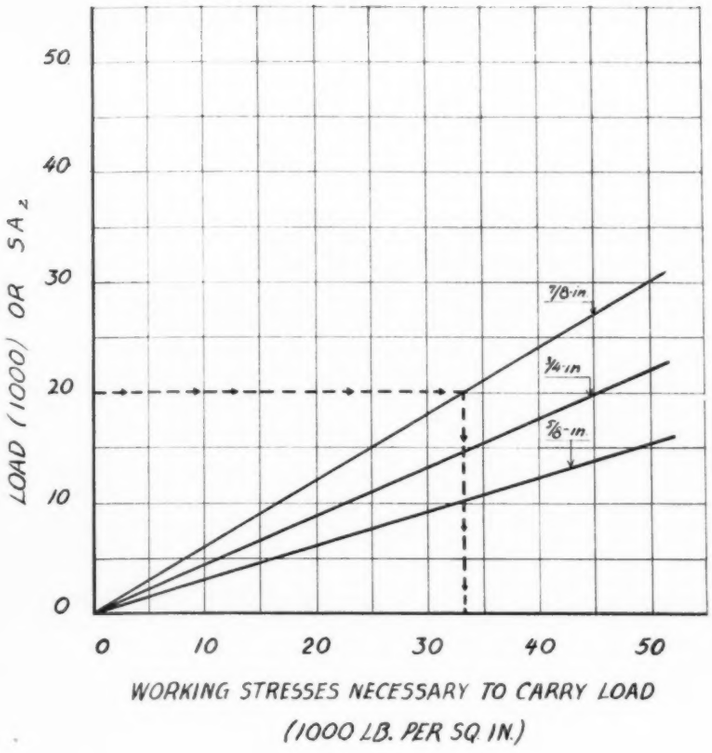


Fig. 1. Chart showing working stress necessary to carry the given well load

This is the first of several articles on the use and interpretation of dynamometer cards from oil wells. Petroleum engineers will find the method of treatment and original material in this and succeeding articles on this subject to be useful in the solution of practical field problems. The formulas in most cases are much simpler than would be expected and wherever possible charts have been prepared to reduce much of the work of computation.

The Design of Sucker-Rod Strings from Dynamometer Cards

By EMORY KEMLER

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Assistant Professor of Mechanical Engineering, University of Pittsburgh

WHILE the title of this article indicates that the information is to apply to the design of rod strings using loads as determined from dynamometer cards, the methods also can be applied to the case where the loads are determined from existing formulas or charts for calculating rod loads. In general, the formulas and charts put out by sucker-rod and oilfield equipment manufacturers give loads that are higher than those that have been measured. They are usually relatively close in those types of wells that produce no gas and operate at normal pumping speeds.

The more important quantities entering in the total polished-rod load are weight of rods, dynamic rod load, rod friction, stuffing box friction, weight of oil, dynamic oil load, friction of oil column, plunger friction, fluid level in well, and load caused by pumping on downstroke. If it were a matter of adding arithmetically these components of the polished-rod load the interpretation of cards, the determination of the most advantageous operating conditions, and the calculation of the maximum load would be an easy matter. The problem is complicated by many other factors of which the following are the most important. One of these is that a force and therefore motion cannot be transmitted along the sucker rods or oil column with a velocity greater than that of the velocity of sound in the material. Another is that because of the relatively high elasticity of these columns, the oil load cannot be picked up or dropped immediately, because the plunger must move an amount equal to the tubing stretch before it can give up or support the entire load of the oil column. The elasticity of the oil column is relatively large. We frequently see the statement that fluids are incompressible whereas oil is about 150 times more compressible than steel, and water is about 100 times more compressible. The amount of free gas in the oil column is a very important item. A small volume of gas will result in a very much lower total oil load on the plunger and will greatly increase the compressibility of the oil column and reduce the speed at which the motion and force can be transmitted through the oil column.

These last three factors that influence the rod load change the shape of the card to a greater degree than they affect the maximum load. One commonly accepted statement, which is often far from true, is that the peak rod load depends on the maximum rod acceleration. The maximum upward acceleration of the rod occurs at the start of the upstroke, and if this were the all important factor, we should expect the maximum load to occur at the start of the upstroke. As a matter of fact, we know that the maximum load usually occurs very near the middle of the stroke

under normal pumping depths and speeds. This fact supports the statements given in the preceding paragraph.

While other factors such as time for the valve to act, the possibility of standing waves of force in the system, etc., enter into the problem, they are usually less important than those already listed.

The success of any calculations based on dynamometer cards depends upon obtaining a representative dynamometer card, and upon the well conditions remaining the same as when the card is taken. Care should be taken to see that the well was not down previous to taking the card; otherwise, the fluid level may not be normal for the particular pumping speed, the oil-water ratio may have changed, and the gas-fluid ratio may not be normal. Likewise, tests taken at different speeds are apt to be misleading unless the time between tests is long enough to insure that well conditions have reached a steady state for each particular speed. Normally, the general trend of a well's performance can be predicted, but in some cases wells suddenly become heavy or corrosive, and in these cases the rod sizes may have to be reproportioned to fit new conditions.

Before the development of the general methods to be used in the design of rod strings, several special cases will be taken up because of their simplicity and application to a large percentage of wells. These special cases will be developed for conditions where the maximum rod load occurs at or near the middle of the stroke. This condition exists in a large number of wells, and the formulas also apply to slow-speed long-stroke conditions where the dynamic loads are low. When the maximum rod load occurs at or near the middle of the stroke, there is no appreciable acceleration force present, and the load is that resulting from the weight of the rods and oil load on the plunger.

SPECIAL CASES WHERE MAXIMUM LOAD OCCURS AT MIDDLE OF STROKE

A. Rod string to be replaced by uniform string of same size but different material.

The problem in this case is one of selection of a material having the proper strength. Changing the material will in no way affect the rod loads since all rod materials have the same modulus of elasticity, so that this analysis applies regardless of the part of the stroke where the maximum load occurs. The stress that the material must be able to withstand is given by the equation:

$$S_w \times A = W \quad - - - - - - - - - \quad (1)$$

Where S_w is the working stress for the material
A is the cross-sectional area of the rods
and W is the load to be carried.

Fig. 1 shows a chart that gives the necessary working stress if the rods are to carry the given load. For instance, if it is desired to use $\frac{7}{8}$ rods when the maximum rod load is 20,000 lb., the material must have a working stress of 33,300 lb. per sq. inch. This value can be checked by substituting in Equation (1). The constants of the various sizes of rods are given in Table I.

TABLE I

Rod Size in Inches	Area A in Sq. Inches	Wt./Lb. (w)	Stretch/ft./1000 ft. (e)
$\frac{5}{8}$	.307	1.15	.00130
$\frac{3}{4}$	.442	1.64	.000905
$\frac{7}{8}$	.601	2.26	.000666

B. Rods to be replaced by uniform string of larger or smaller rods.

In this case, the loads the rods carry will be decreased or increased, depending on whether smaller or larger rods are used to replace the existing string. The direct load on the top rod will, in this case, be given by:

$$W_t = W + (W_1 - W_2)l \quad - - - - - \quad (2)$$

Where W_t = total load on top rod when new string is substituted
W = load on existing string = dynamometer load
W_1 = weight per ft. of new rods
W_2 = weight per ft. of existing rods
l = length of rod string

The rod size or stress that a given size rod must be able to withstand can be determined from the equation:

$$S_w A = W_t \quad - - - - - - - - - \quad (3)$$

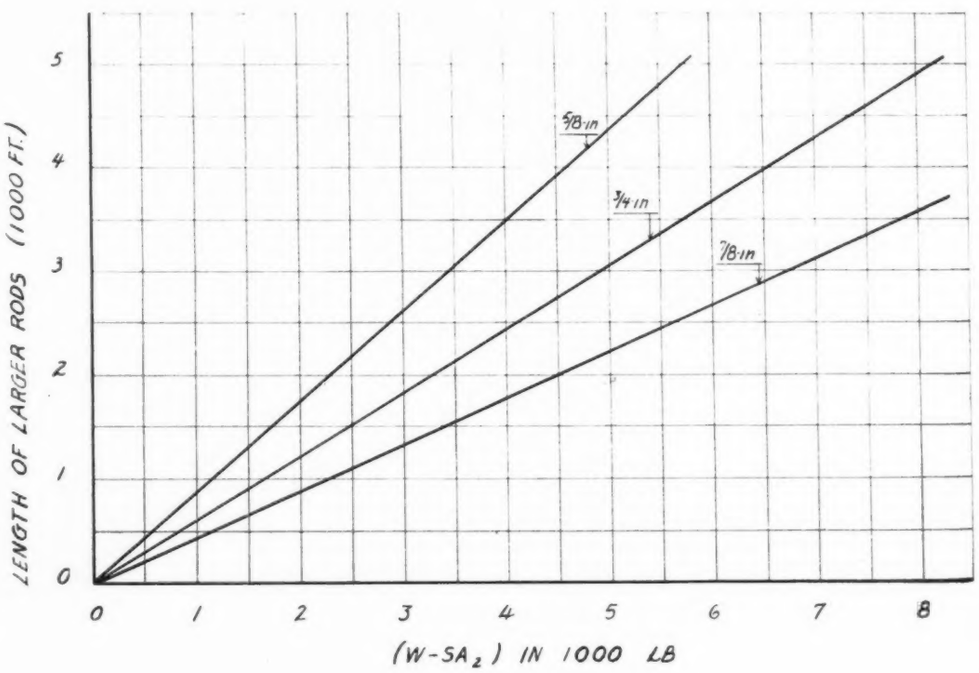


Fig. 2. Chart showing length of larger rods when smaller rods are designed to carry maximum stress

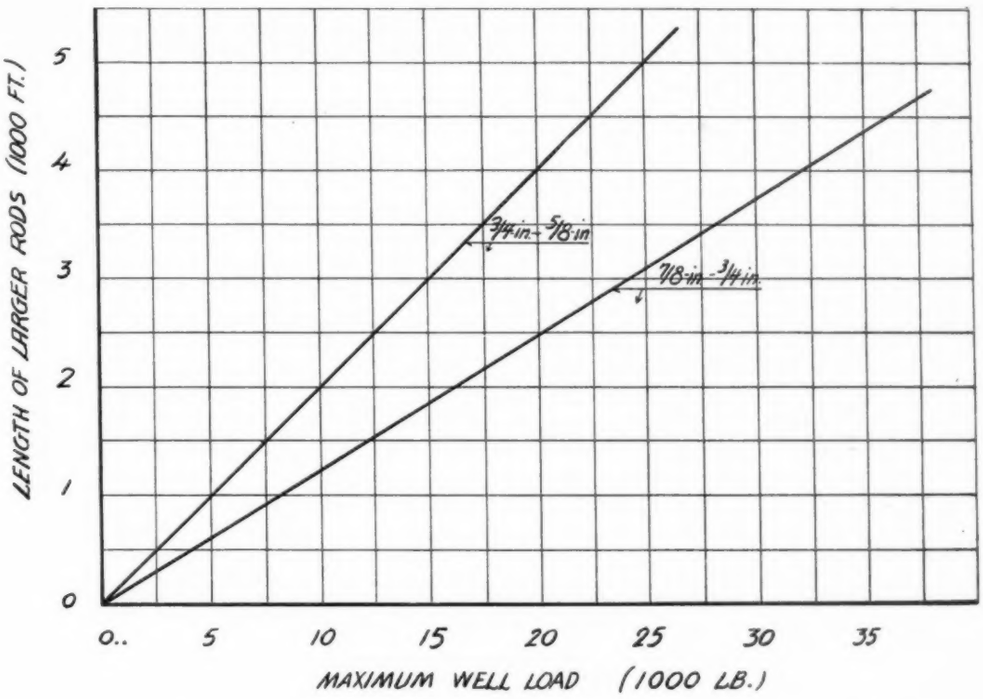


Fig. 3. Chart showing the lengths of the larger rods for the two sizes of strings for any given well load

This problem also can be solved using Fig. 1, everything being the same as in special case A, except that the load used is W_t instead of W. In cases where smaller rods are to be used, W_1 will be less than W_2 and W_t will then be less than W.

As an example, consider a well 3500 ft. deep having ¾-in. rods and weighing 12,500 pounds. If the material of which the rods are made has a working stress of 25,000 lb. per sq. in., Fig. 1 shows that a rod larger than ¾-in. is necessary. Therefore, a ⅞-in. rod must be used. In this case it is necessary to see if this material will be strong enough, or whether a different material, in addition to the larger size, is necessary. Substituting the well load and the rod weight in Equation (2), we have:

$$W_t = 12500 + (2.26 - 1.64)\ 3500 = 14{,}670.$$

Fig. 1 shows that a ⅞-in. rod having a working stress of 25,000 lb. per sq. in. is satisfactory for this service.

The substitution of a different size rod will change the elastic properties of the system, and in case a larger rod is used, the maximum load probably will be thrown earlier in the cycle and probably will be greater than calculated, although this increase, in general, will not be enough to cause any trouble. When a smaller rod is used, the maximum load may occur later and may be slightly less than calculated.

C. Uniform string to be replaced by tapered string with larger size at top.

1. *General Discussion*

A stepped or so-called tapered rod string is, from the practical standpoint, the only way in which the ideal rod string, having the same stress everywhere, can be approached. The advantages of the so-called tapered rod string are that the investment is less, and there is a reduction in load over that for a uniform string having the same maximum stress.

The common method of designing such tapered strings is to determine the position at which the stress in the smaller rods is equal to the allowable working stress, and make the remainder of the string of the larger size rods. Such a procedure results in a string giving the minimum investment and minimum rod load, but may not give the string having the minimum cost per day's service, or per bbl. of fluid produced. This last statement applies particularly to the case where the rods are subjected to corrosion. In any case, a longer operating life for the string would be had by making the amount of both sizes of rods such that the stress is equal in the top rod of each size. Where pitting and general corrosion is present, it is desirable to have the larger rods under the greater stress, since with a given depth of corrosion the percentage reduction of area of the smaller rod will be greater than for the larger size. In case of pitting, the stress concentration will be slightly higher for the smaller rod, assuming the same size pit.

2. *When smaller rods are to be designed to carry maximum stress.*

For the first condition where the rod string is designed for minimum cost we have the following relation, which states that the stress in the top rod of the smaller size is equal to the maximum working stress of this size:

$$W - W_2 (l - l_2) = S A_2 \quad - - - - - \quad (4)$$

$$\text{or} \quad l_2 = \frac{SA_2 - W + W_2 l}{W_2} = l - \frac{W - SA_2}{W_2} = l - l_1 \quad - \quad (5)$$

The length of larger rods is then given by

$$l_1 = \frac{W - SA_2}{W_2} \quad - - - - - - - - \quad (6)$$

Where l_1 is the length of larger rods
W_2 is the weight per ft. of smaller rods
A_2 is the area of smaller rods
and the other symbols have the same meaning as before:
l_2 length of smaller rods
l total length of rods $= l_1 + l_2$

Fig. 2, when used in connection with Fig. 1, offers an easy solution of Equation (6).

To illustrate the use of the formulas and figures, a tapered string will be determined for the loads given in special case *A*; that is, where the rod string is to be replaced by a uniform string of same size but different material. W is given as 12,500 and SA_2 can be found from Fig. 1 by tracing up from a

stress of 25,000 lb. per sq. in. to ¾-in. rods, giving $SA_2 = 11{,}000$, $W - SA_2 = 1500$. Tracing upwards for $W - SA_2 = 1500$ on Fig. 2 to ¾-in. rod size, we find $l_1 = 900$ ft., or 900 ft. of ⅞-in. rods only are needed, and 2600 ft. of ¾-in. rods can be used. It is seen that for this case a considerable savings can be made by using the tapered string.

3. *Tapered string to replace a uniform string designed for equal stresses in each size.*

The equations for this case are considerably more involved but fortunately the design of rod strings by their use is much simpler than the preceding case.

The load at the top of the smaller string is given by:

$$W - W_2 l_1 \quad \text{- - - - - - - - - - - - - - - - (7)}$$

The stress will be given by:

$$S_2 = \frac{W - W_2 l_1}{A_2} \quad \text{- - - - - - - - - - - - (8)}$$

The load at the top of the larger string will be:

$$W + (W_1 - W_2) l_1 \quad \text{- - - - - - - - - - - - (9)}$$

The stress in these rods will be:

$$S_1 = \frac{W + (W_1 - W_2) l_1}{A_1} \quad \text{- - - - - - - - (10)}$$

If the stress in the two is to be the same, equating Equations (8) and (10)) we have:

$$\frac{W - W_2 l_1}{A_2} = \frac{W + (W_1 - W_2) l_1}{A_1} \quad \text{- - - - - - - (11)}$$

$$\text{or } l_1 = \frac{W(A_1 - A_2)}{W_2 A_1 + (W_1 - W_2) A_2} \quad \text{- - - - - - - (12)}$$

While this formula appears to be much more difficult to use, its application is surprisingly simple, and for this reason, is better adapted to practical problems than the other case. When the tapered string is composed of ⅞ and ¾ rods, the length of ⅞ rods required is given by $l_1 = .126\ W$ or the length of ⅞-in. rods can be determined sufficiently accurately by taking one-eighth the weight of the well.

When the string is composed of ¾ - ⅝ rods, the length of ¾ rods is given by $l_1 = .205\ W$, or their length is approximately one-fifth the weight of the well.

Fig. 3 gives the lengths of the larger rods for the two sizes of strings for any given load. Using the example of the special case *A*, we find that 1560 ft. of ⅞ rods are required to give equal stresses in the upper rods of the two parts of the string.

The stress in the top rods of each size (see Fig. 4) is given by equations of equal simplicity, which can be obtained by substituting Equation (12) in Equation (10). The resulting equation gives the maximum stress as:

$$S_{max} = 1.8\ W \text{ for a } ⅞ - ¾ \text{ rod string}$$
$$\text{and } S_{max} = 2.5\ W \text{ for a } ¾ - ⅝ \text{ rod string}$$

In the use of these formulas, it must be remembered that *W* is the load as measured by the dynamometer. The actual load as carried by the tapered string is larger by the amount of the increased weight resulting from the substitution of ⅞-in. for ¾-in., or ¾-in. for ⅝-in. rods. In the case of the ⅞ - ¾ string, the actual load will be 1.078 *W* and for the ¾ - ⅝ string, the actual load will be 1.105 *W*.

4. *Tapered strings with predetermined stresses in each size.*

If the stress in the two sizes has been fixed but is different, we can write, then, that $S_2 = N S_1$ where *N* will depend on the values selected and may be greater or less than *l*.

Putting this value for S_2 in Equation (8), we get:

$$N S_1 = \frac{W - W_2 l_1}{A_2} \text{ or } S_1 = \frac{W - W_2 l_1}{N A_2} \quad \text{- - - - - (13)}$$

Equating Equations (10) and (13), we find:

$$\frac{W - W_2 l_1}{N A_2} = \frac{W + (W_1 - W_2) l_1}{A_1} \quad \text{- - - - - - - (14)}$$

$$\text{or } l_1 = \frac{W(A_1 - N A_2)}{W_2 A_1 + N(W_1 - W_2) A_2} \quad \text{- - - - - - - (15)}$$

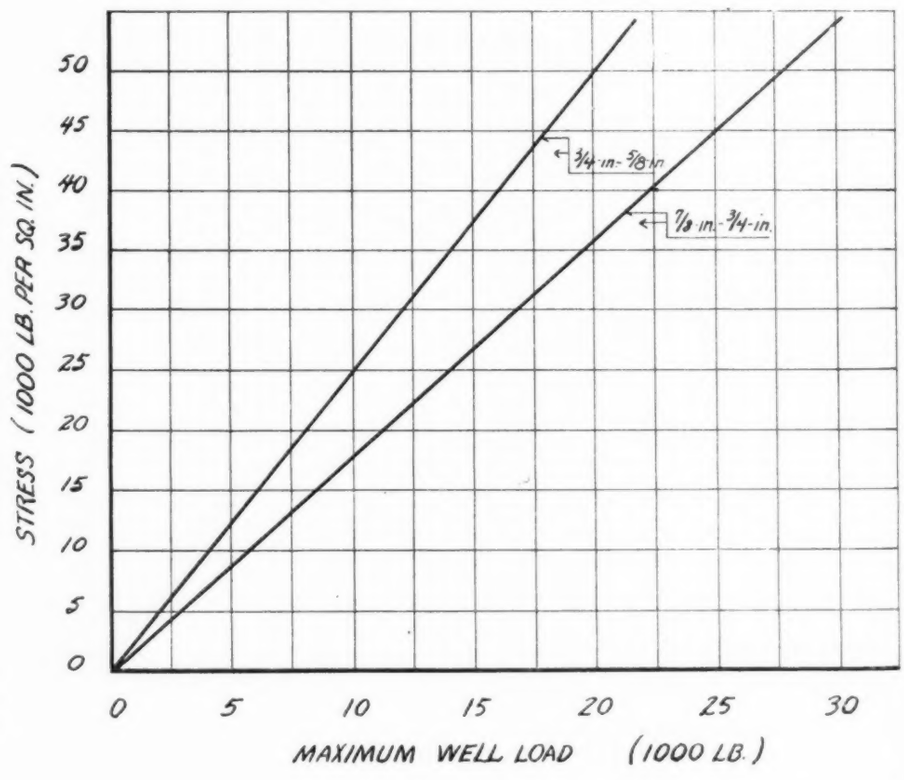


Fig. 4. Chart showing the stress in the top rods of each size for any given well load

For a given value of N this formula will reduce to the same general form as for the preceding section, and the length of larger rods can be expressed as a percentage of the maximum rod load.

D. Uniform string to be replaced by tapered string with smaller rods at bottom.

1. *General case where any stress may be used in each size.*

For this case, the load carried at the top of the smaller rods will be:

$$W - W_1 l + W_2 l_2 \quad - - - - - - - - - - - - \quad (16)$$

and the load at the top of the larger rods will be:

$$W - (W_1 - W_2)\, l_2 \quad - - - - - - - - - - - - \quad (17)$$

$$\text{or} \quad S_1 = \frac{W - (W_1 - W_2)\, l_2}{A_1} \quad - - - - - - - - \quad (18)$$

$$\text{and} \quad S_2 = \frac{W - W_1 l + W_2 l_2}{A_2} \quad - - - - - - - - \quad (19)$$

Again, if we let $S_2 = N S_1$ - - - - - - - - - (20)

$$N S_1 = \frac{W - W_1 l + W_2 l_2}{A_2} \quad \text{or} \quad S_1 = \frac{W - W_1 l + W_2 l_2}{N A_2}$$

- - - - - - - (21)

and equating Equations (18) and (21)

$$\frac{W - W_1 l + W_2 l_2}{N A_2} = \frac{W - (W_1 - W_2)\, l_2}{A_1} \quad - - - - - \quad (22)$$

$$l_2 = \frac{W\,(N A_2 - A_1) + W_1 l A_1}{W_2 A_1 + N A_2 (W_1 - W_2)} \quad - - - - - \quad (23)$$

For a given value of N, the length of smaller rods to be used will depend on the depth of the well, and therefore will be somewhat different from that in the previous case considered, where larger rods were used at the top.

2. *Tapered string designed with equal stresses in each size.*

For this case, $N = l$ and the equation for l_2 reduces to:

$$l_2 = \frac{W\,(A_2 - A_1) + W_1 l A_1}{W_2 A_1 + A_2 (W_1 - W_2)} \quad - - - - - - - \quad (24)$$

Where a $\frac{7}{8}$-in. string is to be replaced by a $\frac{7}{8}$-$\frac{3}{4}$ tapered string the equation reduces to:

$$l_2 = 1.08\, l - .127\, W \quad - - - - - - - - - \quad (25)$$

and for a $\frac{3}{4}$-$\frac{5}{8}$ string that is used to replace a $\frac{3}{4}$ string:

$$l_2 = 1.1\, l - .205\, W \quad - - - - - - - - - \quad (26)$$

The maximum stress in the string becomes for the case of a $\frac{7}{8}$-$\frac{3}{4}$ string replacing a $\frac{3}{4}$ string:

$$S_{max} = 1.8\, W - 1.1\, l \quad - - - - - - - \quad (27)$$

$$\text{and} \quad S_{max} = 2.5\, W - 1.22\, l \quad - - - - - - - \quad (28)$$

for a $\frac{3}{4}$-$\frac{5}{8}$ string replacing a $\frac{3}{4}$ string.

E. Tapered string to be replaced by a tapered string of different length of large rods.

The load at the top of the smaller rods, when the length of larger rods has been changed to l_3, will become:

$$W - W_1 l_1 - W_2 (l_3 - l_1) \quad - - - - - - \quad (29)$$

and the load at the top of the larger rods will become:

$$W + (W_1 - W_2)\, (l_3 - l_1) \quad - - - - - \quad (30)$$

The corresponding stresses will be:

$$S_2 = \frac{W - W_1 l_1 - W_2 (l_3 - l_1)}{A_2} \quad - - - \quad (31)$$

$$S_1 = \frac{W + (W_1 - W_2)\, (l_3 - l_1)}{A_1} \quad - - - \quad (32)$$

If these stresses are to be made equal we have on equating $S_1 = S_2$:

$$\frac{W - l_1 (W_1 - W_2) - W_2 l_3}{A_2} =$$

$$\frac{W + (W_1 - W_2) l_3 - (W_1 - W_2) l_1}{A_1} \quad - - - \quad (33)$$

This reduces to:

$$l_3 = \frac{(A_1 - A_2)\, W - l_1 (W_1 - W_2)}{[\,(W_1 - W_2)\, A_2 + W_2 A_1\,]} =$$

$$.126\, W - .078\, l_1 \quad - - - - \quad (34)$$

for a $\frac{7}{8}$-$\frac{3}{4}$ string.

and for the $\frac{3}{4}$-$\frac{5}{8}$ string:

$$l_3 = .205\, W - .100\, l_1 \quad - - - - - - - \quad (35)$$

The stress becomes for the $\frac{7}{8}$-$\frac{3}{4}$ string:

$$S = 1.80\, W - 1.12\, l_1 \quad - - - - - - - \quad (36)$$

and for the $\frac{3}{4}$-$\frac{5}{8}$ string:

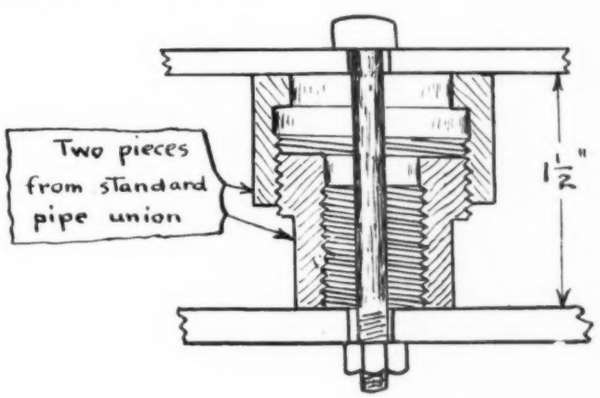
$$S = 2.49\, W - 1.35\, l_1 \quad - - - - - - - \quad (37)$$

Utilizing a Pipe Union . . .

By W. F. SCHAPHORST

WHEN searching for something with a hole through it to be used as a shim or block, try this useful kink. Utilize two of the three parts of an ordinary pipe union as shown in the accompanying sketch. The threads, you see, give a union the desired adjustable feature with a variation range of about half an inch. It is substantial, looks well, and is not a temporary makeshift job. Large unions may be used as well as small, depending upon the fixed distance wanted.

Where distances to be held are greater than the length of a union, a nipple and coupling can be used in the same way.



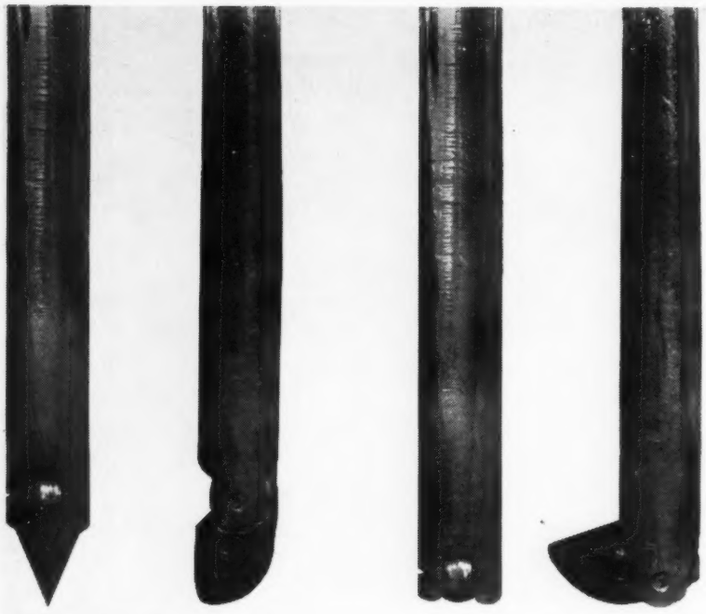


Fig. 35

By

JAMES D. HUGHES

Part VI

Controlled Directional Well-Drilling and Surveying Practice

THE third requisite in the practice of controlled directional drilling as outlined is experience in the factors of deviation and in the art.

The technique of drilling off a whipstock and the subsequent steps in controlling the course of a directed hole must vary with the formations being drilled, the conditions under which it is being drilled, and the mechanical equipment of the drilling rig. It can be seen therefore how enormously important experience in the factors of deflection become in the successful practice of the art. Much of this experience is such that can not be classified and tabulated, being the "feel" that is acquired by craftsmen relative to the work in hand.

Certain general tenets hold true and are used as a foundation upon which to base combinations that best fit the problem at hand. No two wells, nor any two directional drilling problems, are the same, and a combination of equipment and practices that brought about desired results on one well will possibly have no effect upon the other.

For convenience in handling, the writer chooses to divide controlled directional drilling into three classes and discuss the considerations involved in each:

1. Straightening
2. Sidetracking
3. Objective drilling

There are two types of straightening jobs:

(1) To bring a crooked hole back to vertical from existing bottom.
(2) To plug back to point of excessive angle and drill a vertical sidetrack hole.

In the first case the hole may be straightened by one of three ordinary means:

(a) Weighting bottom joint, holding up on the weight and rotating rapidly.
(b) Employing specialty straight-hole bits.
(c) Underreaming and using limber bottom joints with small diameter bit to rat-hole on low side.

Failing in these, or lacking time in which to try them, the removable whipstock can be used to decided advantage. If the crook was not discovered by directional survey first, a single-shot survey is taken on bottom to ascertain the angle and bearing. When the drift angle is not excessive—that is, somewhere under five degrees—a whipstock may be set to drill off the reverse bearing. For instance the hole may have been 5°N 81°E, in which case the whipstock is set to drill off S 81°W, or, as frequently termed, "upside down." Two whipstocks set in this manner would straighten the hole in a gentle curve to within one degree.

Fig. 36

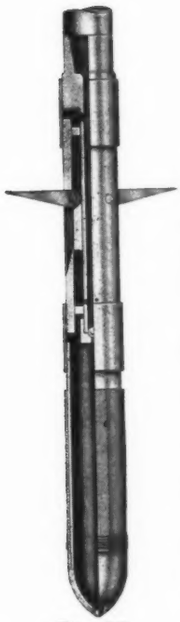


Fig. 37

Fig. 38

At high angles, however, it has been found that setting whipstocks upside down usually result in the bit undercutting the whipstock and continuing on the original course without considerable reduction in drift. In these instances it has been found entirely satisfactory to set the first whipstock so as to derive maximum turn, the second so as to reduce drift with only small turn, and the third so as to reduce drift alone. In this manner a small and tight spiral is created, which irons out easily upon reaming, leaving the hole approximately vertical and with no sharp kinks or reversals.

The second type of straightening job mentioned earlier is the result of a continuous survey, which revealed excessive drift angle at some point above bottom. In this type job the operator may straighten up by one of two ordinary means

(a) "Shouldering up", a process whereby the bit is pulled up to the required point and rotated rapidly without slacking off. The bit digs into the low side of the hole and by feeding slowly, a new hole is sometimes started.

(b) "Plugging back" with cement to the required point and then going in with either a specialty straight-hole or ordinary bit and holding up on the weight while rotating rapidly. This latter method is most frequently and successfully employed.

Conditions are frequently such that ordinary methods meet with little success and directional drilling is resorted to.

Where it is planned from the first to use directional drilling methods, a great deal of consideration is given to the placing of the cement plug. The position of the plug in general depends upon two factors: (1) Point of angularity, and (2) Formation.

The point of angularity is usually that departure exceeding the maximum written into the drilling contract, or if no such restriction exists it is usually a pronounced crook or dog leg that might interfere with the successful running of the casing. If this point occurs on a competent shale body the top of the plug can be placed at the exact point desired; however, if the formation at that point is sandy or too broken to allow the whipstock bit to get a leading bite, thereby causing it to slide down the plug ineffectively, it is advisable to choose a point farther up the hole in a more favorable formation.

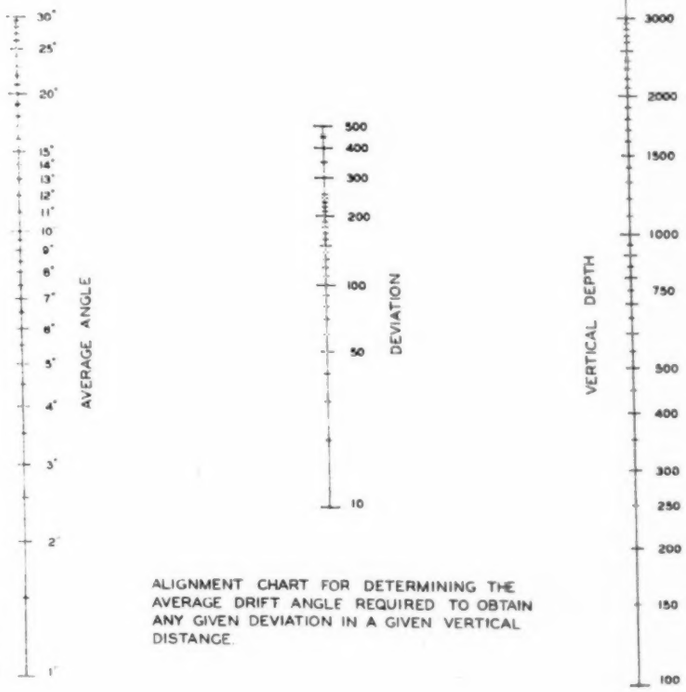
When conditions are inflexible and the plug must be set adjacent to unfavorable formation, a whipstock with the type bottom shown in Fig. 35 is used. The bottom is so designed that it hangs vertically in line with the whipstock body while going in the hole, when bottom is reached the weight applied to shear the pin causes the bottom piece to roll like a sharp-edged cam and throw the bottom of the whipstock fast against the side of the hole. This positively insures the bit being entirely into the wall before leaving the whipstock and thus materially increases the probability of its remaining away from the plug.

In sidetracking plugs in rock-bit formations, the whipstock shown in Fig. 36 is used. Two square-section steel ribs are welded to the back of a regular Oklahoma type whipstock, and two more short ones on the front side of the ring. These sections do not interfere with the free passage of the whipstock down the hole, but when the whipstock is landed and sheared, the back sections hold the bottom of the stock to the side of the hole to be sidetracked. The ring sections throw the top of the stock in the opposite direction, increasing the effective angle of the whipstock.

Another precaution, and incidentally one of prime importance in any operation involving a cement plug, is to obtain as good a cement job as possible. To this end the most approved methods of placing to reduce contamination are employed and the plug allowed at least 72 hours to cure. Even so, a surprising number of plugs, set with extreme care, have been found to be hard only in spots. As the bit must have something harder than the formation behind it to maintain its sidetracked position, it can be seen how vital it is to have a hard plug from which to begin. The writer has seen as many as three plugs set in the same hole before one set up hard enough to be practical.

It was to reduce this unreasonable expense and uncertainty that the writer caused to be built a hydraulically-operated open-hole bridger, Fig. 37, which could be expanded and set at any depth, upon which jointed cylindrical sections, Fig. 38, of precast and fully hardened concrete could be set in any length. In this manner not only can the work be greatly expedited but also considerable economies effected.

Having observed these precautions, the steps in straightening a hole from a plug vary as before according to the



ALIGNMENT CHART FOR DETERMINING THE AVERAGE DRIFT ANGLE REQUIRED TO OBTAIN ANY GIVEN DEVIATION IN A GIVEN VERTICAL DISTANCE.

Fig. 39

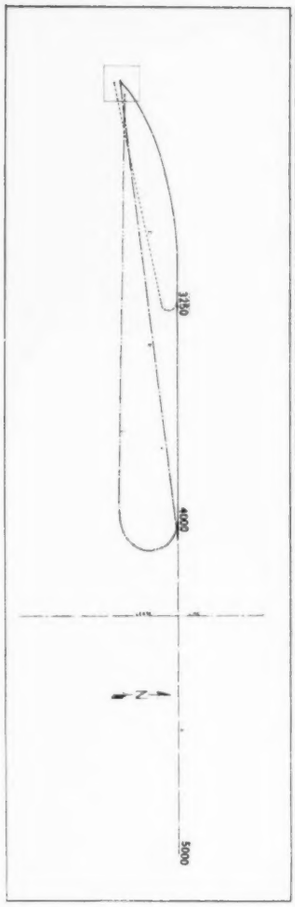


Fig. 40

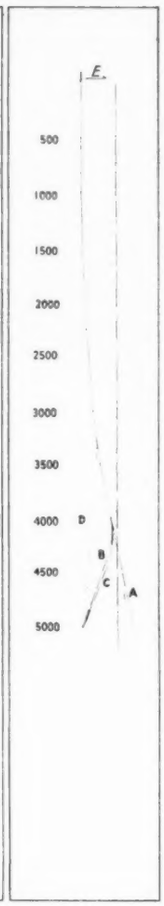


Fig. 40-A

existing angle. The usual practice is not to make a follow-up run behind the first whipstock, but to ream the rat-hole made by the whipstock bit to gauge and set another whipstock with the same setting as the first. In doing this, the bit is displaced from the plug at an initially greater rate, thus establishing a greater likelihood of its remaining away from the plug.

In sidetracking lost tools, bits, cones, and junk in general, it is common practice to use a diamond-point or sidehill bit without placing a short cement plug on top of the junk. In a great number of such instances, the junk is successfully sidetracked only to have it fall in again later with more serious consequences. In using a removable whipstock, however, a short plug is always on top of the fish to fulfill two purposes: to anchor the fish, and to form a good seat for the whipstock. Whenever possible a single-shot survey is made to determine the course of that section of hole containing the junk. The whipstock, unless the operator desires otherwise, is then set to drill off in a direction approximately opposite if the drift angle is low, or around 90 deg. if high. In this fashion the hole is straightened at the same time the junk is sidetracked. If the hole is originally approximately vertical, then two whipstocks are usually set in succession as previously described to insure the new hole from running back into the junk farther down, as in the case of sidetracking drill pipe.

Objective drilling is drilling directionally to an objective established by any one of a number of necessities, a few of which are:

1. Maintaining the course of a hole so that it will bottom up under the derrick, or bringing a trespassing hole back to its proper location within the lease.

2. Deflecting a hole across a fault or out of a gouge zone.

3. Deflecting a hole to the underside of a salt dome overhang to avoid heaving shales and rock-bit digging, or if the hole is in the salt body, deflecting it out.

4. Deflecting a hole to a point under an inaccessible location from an offset location.

5. Deflecting a workover sidetrack hole to a more productive point on the lease, or up structure to escape encroaching waters.

6. Deflecting a relief hole to kill wild burning or cratered wells.

7. Deflecting a series of sidetracked holes for geological exploration.

8. Deflecting a plurality of wells from one location.

In every case the objective is given as a required horizontal deviation in a given direction and at a given total depth. In application 1, 4, 6, and 8, definite points prevail, while in the remainder, being purely geological, the objective may be moved from time to time as more geological information is brought to light.

Having been given the required deviation and direction the factor of drift angle is the next consideration. Some operators require that this angle be as low as possible while others require that the amount of new hole be kept at a minimum. However, it has been the writer's experience that an average drift angle of from six to eight degrees is most satisfactory on deflections up to 100 feet. Once gaining the initial deviation in the required direction it is easier to control a hole at high angles than at smaller angles. On occasion holes have been deviated at angles as high as 45 degrees in California fields.

Knowing the average rig cost per day, the average directional footage per day on any particular type job, the approximate cost of building up to any required angle, it is possible to calculate the point of plug back to gain maximum economy.

The alignment chart shown in Fig. 39 is of material assistance in closely approximating the average drifts required to obtain different deviations at various amounts of vertical footage.

Figs. 40 and 40A illustrate the case of an intended 5000-ft. hole that was surveyed at 4000 ft. and found to be 273 ft. N 82°49′ E with a drift angle of 12 deg. on bottom. The location being 300 ft. from the line, it is obvious that if the hole is continued at its present trend it will bottom well under the adjoining lease as shown in broken line A.

The operator desires to bring the hole back under the derrick by directional drilling. To do this by reversing under, or undercutting at 4000 ft. (broken line B) would require approximately 13 whipstock settings; and to turn it back (broken line C) would require 16 whipstock settings; however, by plugging back to 3250 ft. where the hole is only 138 ft. from the derrick and a drift of seven degrees obtains it will require only six whipstock settings to bring the well back (broken line D). There will be little difference in time between C and D, however, in using method D, the operator saves approximately 50 percent on the directional drilling expenditure besides having a better hole in which to run casing.

Coating and wrapping line before lowering in stream bed.

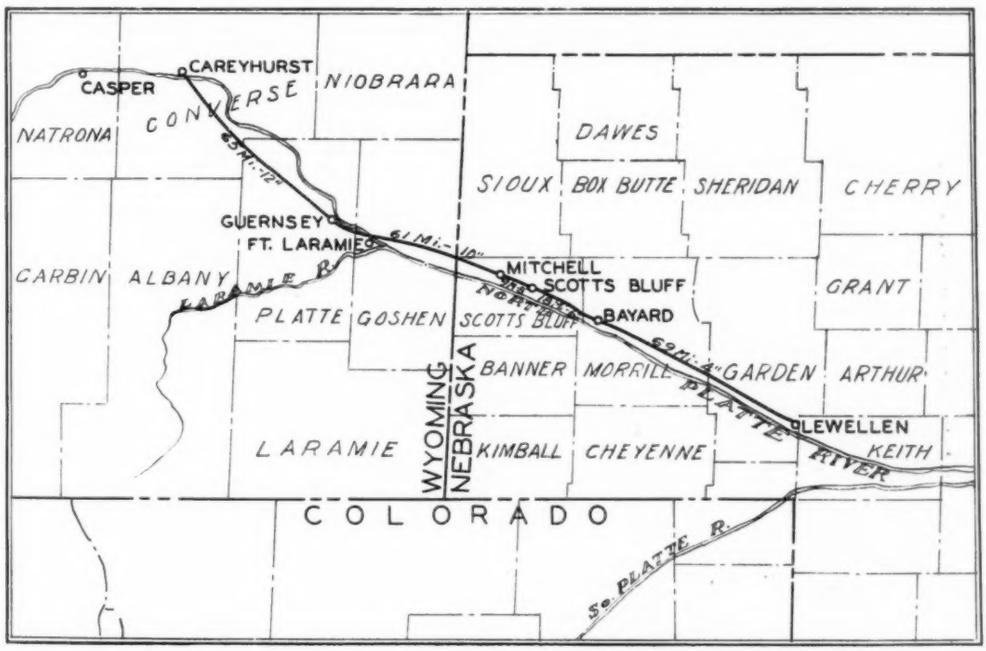
Unusual Methods Required in Completing Wyoming-Nebraska Natural Gas Line

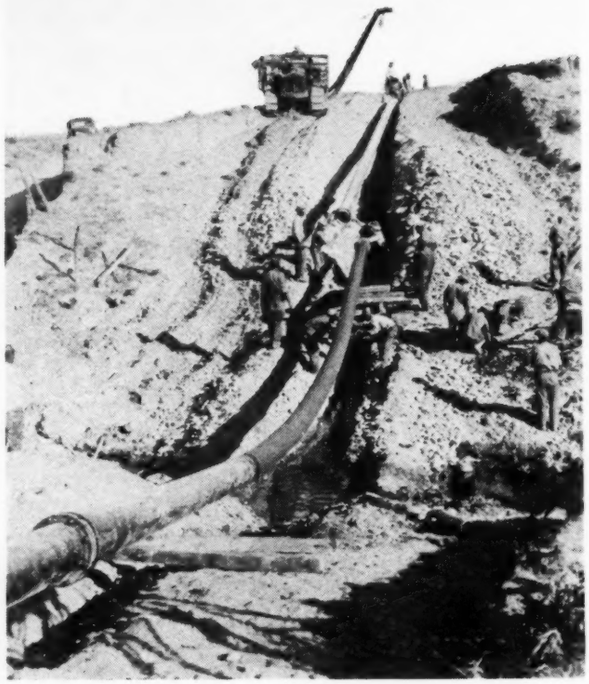
Transportation difficulties during construction due to mountainous country was formidable obstacle.

By LEO H. TOWERS

TRACTORS rolling over and over down mountain sides and hauling pipe a distance of 200 miles with trucks under no strain but with the same trucks boiling on the empty return trip were but two of the many unusual conditions encountered in the construction of the new natural gas line for the North Central Gas Company. This 222-mile line originates at Careyhurst, Wyoming, and extends southeastward along the North Platte River to Lewellen, Nebraska. It supplants a parallel line that the company has been using but that was leased from the Stanolind Pipe Line Company.

Map showing route of the line in eastern Wyoming and western Nebraska.





A ravine section being coupled into the line. Note how right-of-way has been cut in side of hill to make roadway for trucks and ditchers.

The Stanolind line, which was originally built to transport crude from the famous Teapot Dome area to the east, will be taken over by the owners and put in service again as an oil carrier.

Construction work was started by Williams Bros., Inc., of Tulsa in September and the line was completed by December 1. The fact that it was almost time for the sugar beet harvest in western Nebraska delayed work on that end of the line until after October 15. Weather favored the contractor during the major part of the work, although zero weather was encountered before competion and some snowfall made transportation slow and hazardous. On several occasions the backfilling crews were only a day or two ahead of heavy snows.

Both new and used pipe varying in size from 12 in. down to 4 in. was used on the line. From Careyhurst to Guernsey in Wyoming 65 miles of new 12-in. pipe was used; from Guernsey to Mitchell, Nebraska, 61 miles of 10-in. pipe of which approximately one-half was new; from Mitchell to Scottsbluff, 9 miles of used 8-in. pipe; from Scottsbluff to Bayard, 18 miles of used 6-in. pipe; and from Bayard to Lewellen, 69 miles of new 4-in. pipe completed the line. The new pipe was manufactured by the Republic Steel Corporation of Youngstown, Ohio, and delivered along the route of the line to the nearest railroad station. The used pipe was supplied by the American Pipe and Supply Company of Casper, who contracted with Williams Bros. to condition the pipe. An elaborate cleaning yard was established at Casper, covering an area of ten acres, where all the pipe used for this line was serviced, and in addition about 60 miles more of reclaimed pipe was cleaned and stacked. The pipe supplied to the cleaning yard came from abandoned lines in the Casper, Salt Creek and Alcova districts. W-K-M pipe-cleaning machines were used to clean the pipe. A close inspection of the pipe was made after cleaning. Small pits were electrically spot-welded and the pipe was given a primer coating of paint. Only about 15 percent of the pipe brought into the yard failed to pass the inspection and was discarded as unserviceable.

From the cleaning yard at Casper the contractor did his own hauling and stringing to the pipe line. The hauling averaged 200 miles per trip one way, and 16 International and three Indiana trucks were used for hauling. All trucks were equipped with hydraulic brakes before work started and were required to haul from altitudes of 8000 ft. to 2000 ft., a drop of 6000 ft. in a little more than 100 miles. For that reason it was not uncommon to have a loaded truck travel long distances at the expense of gravity but the empty return trip would find the truck motor overheated from the long upgrades. The average haul for new pipe from the railroad to the line was 12 miles. Toe tractors were used to get the trucks off and on the highways, sometimes two tractors being required for a single truck. The contractor provided transportation for the work crews, thereby eliminating construction camps along the route. Because the section through which the line passes is sparsely settled it is usual to provide camps for construction crews for highways, pole lines, etc. In order to reach towns of sufficient size to house the crews it was sometimes necessary to travel as far as 40 miles between the line and town. A very important item that was constantly watched by the contractor was the extra supply of water. Each truck was provided with a water drum, and it was always refilled at the first opportunity after water was used from it. In addition each workman carried a water bag.

Preparing the right-of-way so that it could be used by the stringing trucks and then by the ditching machines proved to be a road-building job. The right-of-way paralleled the Stanolind line with the new trench never closer than 12 ft. nor farther than 100 ft. from that line. Baker Angle Dozers or Trail Blazers attached to the fronts of tractors were used to make the right-of-way accessible to the trucks. Because so

Coming over the crest of a hill with a bended section of pipe

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• Notice from the drawing above how Trimo's jaw swings back and forth 3/32 of an inch more than any other type. Just that added extra 3/32 of an inch places Trimo miles ahead in wrench performance. It means a quicker bite, tighter grip on the pipe and an easier release when you swing the wrench back to its original position.

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Two bending crews working double shifts were kept busy due to rough terrain.

much of the line lay along mountain slopes it was necessary for these trail blazers to "dig in" on the up-slope and fill in on the down-slope. Once the roadway was leveled off it could be used for both the stringing of pipe and for the ditching machines. Ninety miles of the line was in mountainous country with the most difficult section circling the base of Laramie Peak.

The three construction crews used six Buckeye ditching machines and 30 Caterpillar tractors with booms attached. Real skill was required in the handling of the tractors on the steep slopes. It was not uncommon to have one overbalance and roll down grade. According to G. S. Connors, general superintendent for the contractor, he has witnessed a tractor making six complete loops before reaching terrain level enough to stop it. Ditching machines found slow going due to the large amount of hard rock and numerous field repairs were required for the ditchers to keep them functioning through the hard rock country. Blasting was resorted to along almost the entire length of line. Two bending crews working double shift, or the equivalent of four full time crews, were kept busy making horizontal and vertical bends.

On all but the lower 55 miles of the line the joints were alternately electric-welded and Dresser-coupled. Two joints of pipe formed a firing line section for welding and Dresser couplings were added at each end of the section. H. C. Price, Inc., of Bartlesville, had the welding contract for the line. By using the short sections a distinct advantage in making bends and placing the pipe was obtained. Each section could be brought into position over the trench and then coupled just before lowering. From the operator's standpoint the coupled line will allow for more flexibility to meet the climatic changes of the region. The 55 miles of new 4-in. pipe laid between Bridgeport and Lewellen, Nebraska, was acetylene welded. Many deep ravines or gulches were encountered in the higher regions. The smaller ones were spanned by the line but where the gulch was too wide to span and too deep to drop down to bottom in a detour was necessary. As much as a mile or mile and a half of extra line sometimes was required.

The North Platte River was crossed in two places; once near the start of the line at Careyhurst, and again at Fort Laramie. At each crossing heavy river clamps were used and the bottom of the river dredged to anchor the single line crossing. Several small mountain streams were crossed in which river clamps were used because of the danger of the intermittent torrents to which those streams are subjected.

In Nebraska irrigation canals were encountered every mile; most of these were from 20 ft. to 30 ft. wide and from 10 ft. to 12 ft. deep. The usual procedure for crossing was to tunnel under the canal, although in some places an overhead crossing was made. In the latter cases a truss type pipe support was made to carry the line over.

"Hot spots" or corrosive areas along the line were determined from the records on the Stanolind line. These spots were the only places where the line was given more than the primer coating. At "hot spots" the line was further coated with hot enamel and then wrapped.

At the present time no booster stations will be built along the line, the present station at Careyhurst being sufficient to carry the volume of gas being delivered by the company.

In charge of construction work for the North Central Gas Company was J. M. McIntire, vice-president and general manager. In addition to Mr. Connors, Williams Bros., Inc., had H. L. Davis, J. H. McCartney, A. N. Garber, G. A. Manuel, as general foremen, and "Mutt" Fisher as stringing foreman.

Moving a completed firing line section into place for coupling to main line

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Great Strides Made In Acid-Treating Wells

Controlled directional treating of wells with acid may become common practice in near future « «

By J. C. ALBRIGHT

PROGRESS made in treating oil wells with acid has been truly remarkable, not only from a technical standpoint, but in the development and uses of mechanical devices. Within the comparatively short space of three years, wells have been treated in practically every state, as well as foreign countries, where oil is found in limestone rock. As a result of such treatment most of these wells have shown a substantial increase in production.

In reviewing the methods employed in the application of hydrochloric acid to oil wells credit should be given to those who pioneered in the field. When acid was first used in large quantities it was applied to the limestone formations to increase the daily production of the individual wells. The application was made because it was well known that limestone could be dissolved by acid, but little was known concerning the many other features of this form of treating.

The first year and a half or two years after acid had become to be widely used throughout the country, and during that time, many companies were formed to treat wells; and producing companies created organizations to do their own treating. In many instances this resulted in treating wells merely by 'dumping' the acid in the casing—a practice that was instrumental in the coinage of the word 'acid dumpers' and other similar names.

During that time, several of the larger companies that were using acid to treat wells owned by producing companies, and the producers themselves, began to investigate the process to determine if there were better methods of treating wells in limestone than merely pouring or pumping a certain amount of the chemicals into the wells. The petroleum engineers began to study logs of the individual wells, and it was found that many wells that were producing from limestone were giving up the oil from the more porous portions at the expense of the tighter ones.

Because of this interest many new wells drilled since treating wells with acid became successful were more closely watched by the geologists and complete logs maintained showing the difference in porosity and permeability between one zone and another. It has been discovered that many wells were producing the bulk of the oil from the more open portions of the zone, and thus caused the formation pressure to be lowered to a point where the tighter formations could not be produced successfully.

Acid treatment of wells has progressed to such an extent than many wells are given a treatment immediately following drilling-in to open up the tighter zones so the entire formation may be drained uniformly. Wells that are classed as, for instance, 10,000-bbl. wells can be produced only at a rate fixed by proration regulations, yet are treated to open the formation. Formation pressures may approximate, say, 1500 lb. and the pressures at the drilled hole dropped to 1100 lb. in untreated wells; however, if treated when first brought in there is little change in formation pressures at the bottom of the hole, for the oil travels to the hole with a smaller pressure drop. The increased bottom-hole pressure when acid is used shows that the oil is coming from the formation with less friction and consequently less gas energy. If the formation is tight and no treatment given to open up the pores in the limestone, the pressures may drop so low that gas will come out of solution, and the bubbles of gas so formed in the limestone will greatly retard the flow of oil to the well. Gas easily may be removed, or released, from the oil, but it is difficult to put it back again once separation has taken place.

In the early days of acidizing oil wells, the acid was permitted to travel largely as it would, which was downward, outward, and always through the path of least resistance. This method did not always produce satisfactory results because the water zone was just as apt to be opened as the oil-producing formation, causing the well to make more water than oil. To overcome this difficulty bottom-hole 'blankets' were developed to provide an effective seal to the lower part of the hole, preventing acid from traveling in that direction. Treating wells with blankets is perhaps the forerunner of directional-treating of oil wells. The development of blankets gave the treating companies an opportunity to control the flow of chemicals by preventing it from flowing downward.

(Continued on page 51)

By 1934 it was BREAKING

● Before two years had passed, casing made by the A. O. Smith Corporation was set at depths never attempted before for slip-joint casing, run welded. It was breaking records then, just as SMITH*Welded* Cracking Stills were in '27, SMITH*Welded* Line Pipe by '29. Like them it was pointing its own way to greater developments.

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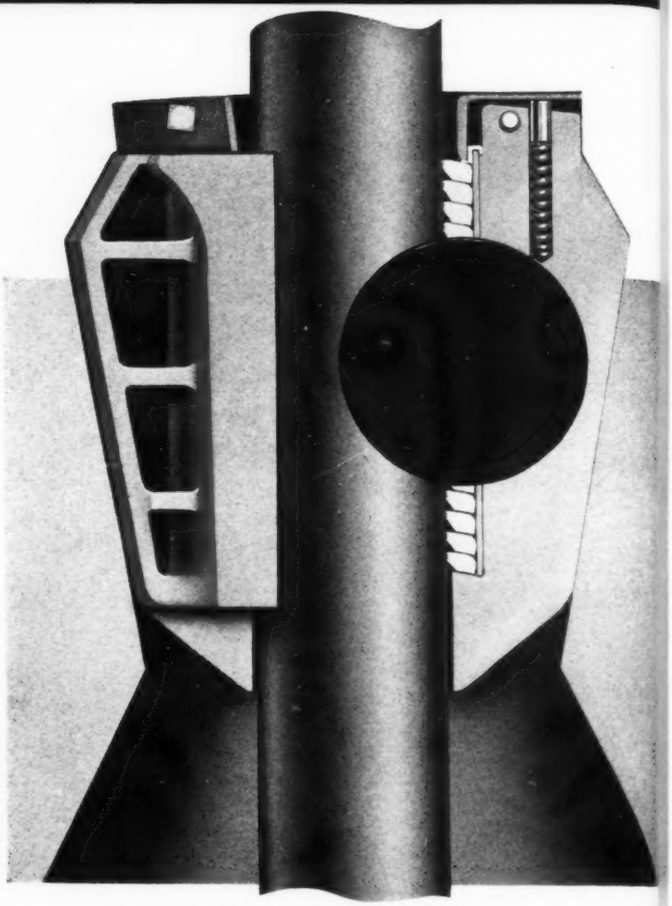

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(Continued from page 47)

The blankets are acid-proof materials, heavier than the treating acid, and do not permit the penetration of acid below the point where they are laid down. Some of the blankets are made of a 40-deg. Baumé solution of calcium chloride, which can be removed from the hole after the treating has been completed. It may, however, be composed of any other chemically inert substance heavy enough to settle to the bottom of the hole and remain in place while the treatment is being carried on.

Treating wells to increase the production of oil, strictly speaking, is not a science, rather it is an art. Science plays an important part in the process, but, since each well must be considered as an individual problem, the results depend largely upon the ability and common sense of the man applying the acid. The selection of the proper blend of acid falls in the scientific class, because some limestones react upon an application of a dilute acid, while others require a catalyst to speed up the reaction. Progress is being made in this direction also, and some of the companies who pioneered in the field have created research laboratories to cooperate with the petroleum engineers of producing companies and carry on a research campaign.

It always has been comparatively easy to pump acid into some wells where the formation pressure is low and the porosity is high, but difficulty was encountered in obtaining pumping units that would apply enough pressure to force the acid into the tighter limestones and yet be light enough to carry on a truck. Progress has been made in this direction until pumping units are available that will cope with any pressure required.

Strength of acid has been investigated more thoroughly during the past year than at any time previously. It has been found that if a highly concentrated acid is injected into a well with little or no water added one of two things happened at the bottom of the hole: It either worked so rapidly in some formations that it did not penetrate into the pores any distance, but merely increased the size of the bottom of the hole; or, it was found that the water formed by the reaction in the pores of the rock was not sufficient to dilute the calcium chloride salt to the extent that it could be brought out readily and thus open the formation.

In this respect, again, progress has been made. Making a complete record of the well showing the porosity, the permeability, and the type of limestone encountered is now general practice. From this record the acid-treating department can determine readily what strength to use to obtain the most desirable results. Because of the difference in performance and character of the individual well, even though it may be an offset to another drilled to bottom in practically the same type formation, no hard and fast set of rules can be followed in treating. If each well in a given pool were an exact duplicate of the others drilled nearby, a routine could be followed that would greatly simplify acid-treating practice.

In addition to determining the exact concentration of acid to be used and the best procedure to follow in its application, two other important considerations must be kept in mind: protection of the physical equipment in the ground against corrosion and disintegration, and assurance that the oil produced is of such character that subsequent refining will not cause a corrosive condition to result in the manufacturing plant.

Inhibitors were used early in the application of acid, but those selected at that time were not all that could be desired. A combination of two or more chemicals designed to retard or prevent corrosion of the steel casing and tubing is being used, and those used a year or so ago have been discarded for others now known to have more desirable properties. Research is being carried on continually by the larger treating companies, as well as by the oil-producers, in order to develop more efficient inhibitors even than the ones in use today.

The trend in treating wells with acid is toward more efficient treaters, the selection of men who will know what to do in cases of emergency. If the procedure could be outlined by formula, the problem at the well would be reduced to a few set rules, but so much acid pumped into so many feet thickness of limestone will not always prove satisfactory. Here is where the human element enters; the operator of the acid-treating equipment must not only be familiar with the chemicals, but he must know what to do in case the well is to be treated in the upper portion of the producing zone rather than in the lower. The rate of injection must be controlled, because two strata of limestone may be closely associated, one of which is so much more porous and having greater permeability than the other. The problem then is to open the tight zone to permit the oil to be produced from it at the same time the more porous formation is producing. It has been found that if acid is pumped into a well of this character at a rapid rate, the more open layer of limestone will take the acid at the expense of the tighter one; therefore, the rate of pumping is slowed down to allow the chemicals to react in the tighter formation so drainage channels can be formed.

The problem of treating wells with acid is an intricate one and it would be folly to say that because one well responded to a certain treatment another would be benefited likewise by following the same procedure. The one may have a producing zone uniformly porous and with the same permeability through the thickness of the limestone, while the offset may have hard streaks and layers of varying permeability laid down one upon the other. Naturally the process must be varied according to the well. Since this is true, bottom-hole conditions must be known to the fullest extent. All possible information is gathered while the well is being drilled from which accurate logs are made that may be available for future work.

The art of treating wells has progressed sufficiently that they may now be treated through perforations in the casing at any desired point in the well. Limestone penerated while drilling, where an insufficient amount of oil showed, have been treated by plugging-back and perforating the several strings of casing and cement. It is difficult to predict what will happen a year hence, but judging from what has occurred during the past three years, one may be justified in saying that the "art" will be improved upon greatly. Combinations of chemicals undoubtedly will be used and mechanical devices developed to permit directional treating. By the term directional treating is meant the practice of blocking-off part of the hole so the acid will travel in a definitely controlled horizontal direction.

Shock Absorbers for Foundation Bolts » »

Sound practical hints on the setting of machinery foundation bolts in concrete that will reduce failures.

By ELTON STERRETT

A SURPRISINGLY LARGE percentage of breakdowns and lost time sustained by field equipment, such as powers, pumps, compressors and the like, is due to failure of a relatively small but extremely important unit in the machine set-up—the foundation bolt—for, unless securely fastened to its base, vibration will sooner or later wear down the strongest equipment and cause serious damage.

On the usual run of field installations the foundation bolts are cast integral with the concrete, being lined up somewhere in the vicinity of the position shown in the equipment manufacturer's specifications with a foot rule and a hammer. Then, when the pump, power, or what not is set, the stub ends of foundation bolts projecting above the concrete are battered, pounded, and bent until finally persuaded to line with the holes in the machine base.

Unless the machine be in perfect balance and working against absolutely stable conditions, one or more of the foundation bolts becomes overloaded and gives way. With one out of service, stresses rapidly pile up on the remaining bolts and failure of the machine through a broken base or internal wrecking under distortion, is sure to follow.

Inspection of the two ends formed by a break in a foundation bolt show at once whether the failure was due to having installed too small a bolt—in this connection, the equipment manufacturer's recommendations are generally ample and if followed should practically eliminate this source of trouble—or whether the break was a by-product of vibration. There is a third class of failure—induced by too long a "persuader" slipped over the wrench handle by a careless or ignorant member of the erection gang—of which the break parallels in appearance the first-mentioned type.

The bolt that fails through overload or excess tension shows the characteristic reduction in cross section at the break, ranging from the slight neck found in high carbon steel to as high as half the original sectional area in ductile steels. If the break be found and examined before rusting has set in, the metal is seen to be very fine-grained or of a silky, fibrous texture, usually with a cup rimming one side of the break and a corresponding cone projecting above the plane of fracture on the other.

Where vibration is the cause of the break, however, the bolt in all probability will show little or no reduction of cross section, and the metal surface is observed to be composed of coarse grains, sometimes as large as sugar crystals or table salt.

One oil company, which found its foundation bolt failures falling about equally into the two classes, undertook to eliminate this factor from its maintenance; succeeding remarkably well by adopting the suggestion of one of its engineers that the bolts be cushioned in rubber.

For this purpose no special material had to be bought or made up—a section of rubber hose being forced over the threaded end of the bolt. When used to fasten lighter types of machines, electric motors, and air compressors, this rubber need extend into the concrete only a short distance. This company standardized on a minimum extent of eight diameters of the bolt as giving adequate protection against both vibration and localizing of tension stresses.

The bolts, each with its rubber "shock absorber" in place, are set individually with the hose extending to the top of the thread and serving as protection therefor during concreting—as shown on the middle bolt of the three in the photograph — or they may be fastened to the jig or template that holds the bolts in place during the casting and setting of the concrete base. In this example, no washer or other extension is used on the head of the bolt, as here, again, burying the bolt head for more than six times the shank diameter provides a grip in the concrete matrix that will hold the steel until the shank fails rather than the head pull out.

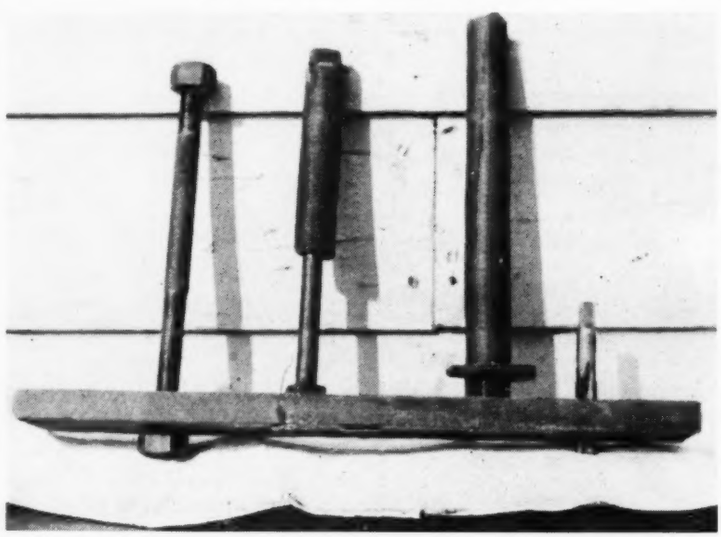

Fig. 1. Types of hose "shock absorbers" applied to foundation bolts to afford stock to take up vibration and allow tension to be distributed through steel

When so protected, the section within the

(Continued on page 56)

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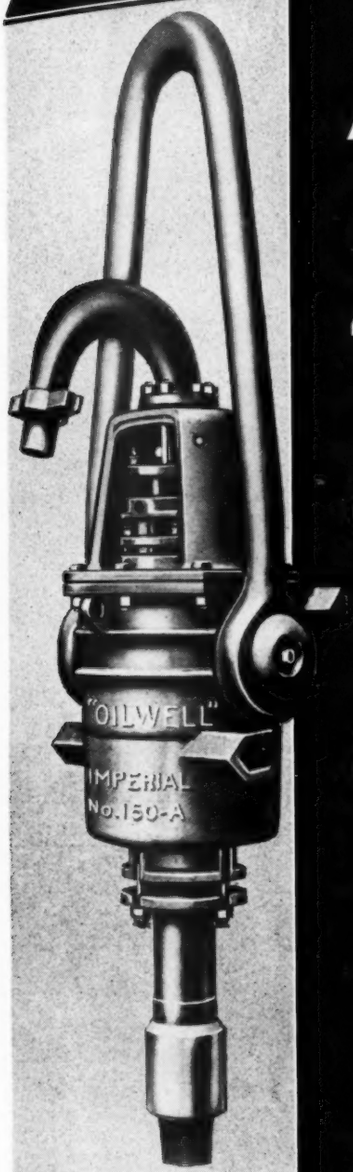

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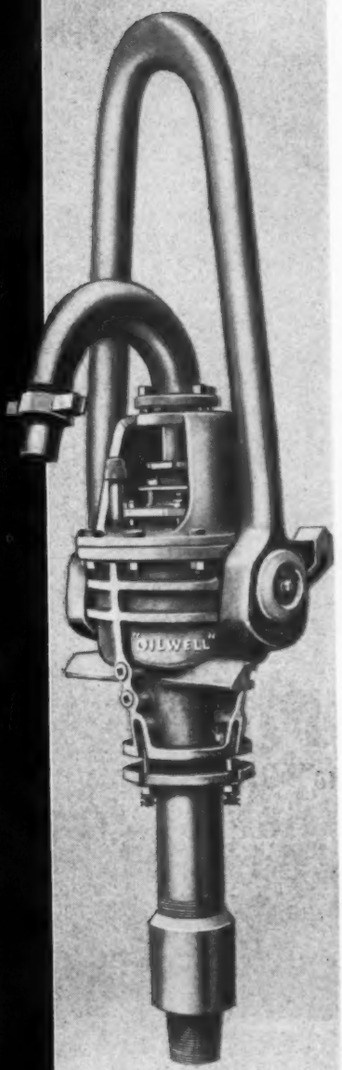

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OKLAHOMA CITY AND SEMINOLE: Equipment at these Branches is being replaced with new Landis API Pipe Threading Machinery to handle from 2" to 16" inclusive and representing an expenditure of about $35,000.00.

WICHITA: A New District Office, located in the Union National Bank Building, has been established to better serve the increased development in the State of Kansas.

RUSSELL: We have established a new Branch in Russell, Kansas, where we carry a complete stock of casing, tubing and line pipe.

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(Continued from page 52)

hose is free to be shifted slightly to accommodate stresses; and vibration, instead of being concentrated in a very short section, is free to dampen itself out through several inches of steel with the result that the establishment of a fixed node, present in a bolt solidly cast in concrete, is smothered by the rubber mounting.

Likewise, instead of the excess pull either from working conditions or the aforementioned illegal "persuader" on the wrench being counteracted by the elasticity of only a short section of steel, it is distributed through the length of the rubber-covered section and can yield within its elastic limit and absorb a strain that would inevitably result in rupture of a bolt rigidly held clear to the end.

A further development of this plan of rubberizing foundation bolts appears at the right of the photograph, where the hose section is long enough to envelop the bolt completely. Here a washer or other hold-down plate is used to insure adequate bearing. Such a bolt may be shifted within narrow limits inside its sheath, permitting accurate alignment for jobs where a close fit is required.

When such a rubber-protected bolt is set in concrete, the excess bit of hose covering the thread that will be within the machine base is cut off—usual practice being to leave it projecting ¼ in. above the final bottom line of the machine base so as to form a tight seal with the base when the nuts on the bolts are pulled home.

By using a foundation stud instead of bolt, of the type shown at the left of the illustration, it was found feasible to use a high-tensile steel and to salvage all but the nut and washer buried in the concrete when the need for the machine at any particular location is finished. By dipping the end of stud with the nut already in place, into a bath of melted paraffin, a protective coating is formed that will keep water in the concrete from getting at and rusting the threads within the nut, and will permit pulling the studs from their rubber sheath by unscrewing with a stud puller or doubled nuts on the exposed end after the machine has been moved.

Another kink for use in casting field foundations that this company developed saves much time in lining up bolts and insures accurate alignment. Instead of fastening the bolts alongside the jig or boring holes that will take the bolt end —usually several sizes too large—the manufacturer's foundation plan is carefully transferred to the template and small holes drilled that will tap out to the size thread carried by the foundation bolt. When the bolts are screwed into the wood and the nuts run down atop them to lock the wood to them, the wood serves the dual purpose of protecting the thread ends, even against rusting, as well as holding the bolts firmly against accidental displacement during the casting and setting of the foundation.

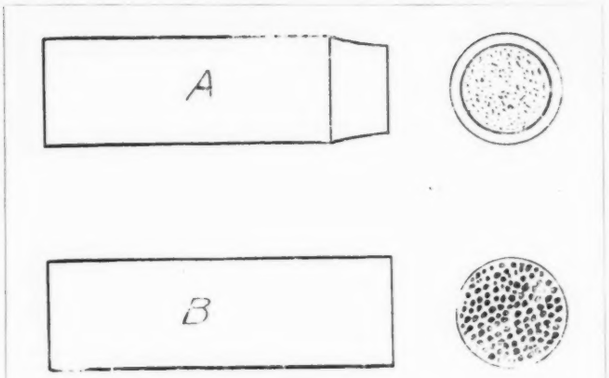


Fig. 2. A—Bolt failing in tension. B—Bolt failing under vibration. Relative grain sizes are approximated by the dotted sections, as is the reduction in cross section under tension above elastic limit

In the illustration a bolt—its hose protector left off to show the threads—is screwed into one hole of a cross strip from a template, while the bolt tap used to thread the holes in the wood still stands in the companion hole. To simplify the obtaining of the phtograph and permit the grouping of the various bolt types in one view, this board and bolt are shown upside down and would, of course, be reversed in service.

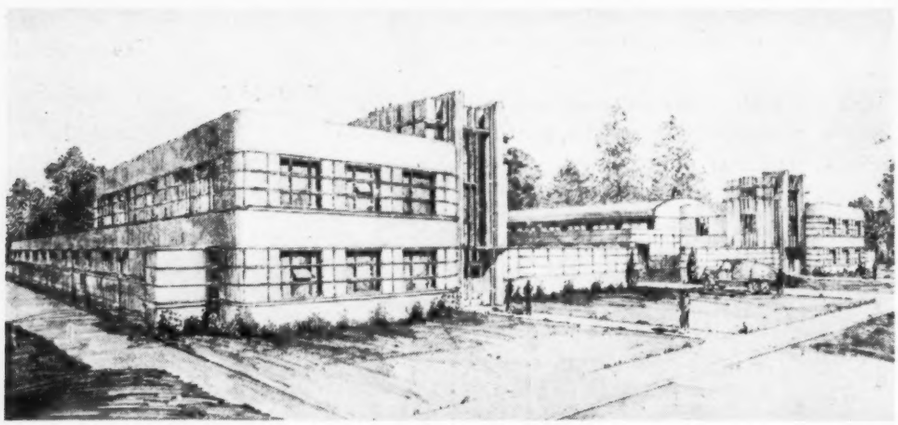
There are available various types of rubber hose to fit almost any diameter of foundation bolt that may be specified and as the rubber seems to undergo but little deterioration after being enclosed in concrete, there is no need to purchase new hose; scrap or salvage material, in short lengths, will serve just as well.

Where the bolts are to remain permanently in their rubber sleeves, forcing the hose over the bolt may be done most easily by wetting both thoroughly with water. If it is intended to salvage the stud later, as when made of high-tensile steel, a thin coating of oil rubber onto the steel will aid in placing the hose, and the small amount can be absorbed by the rubber without causing appreciable change in its structure or impairing its service.

Lane-Wells Company Constructing New Plant

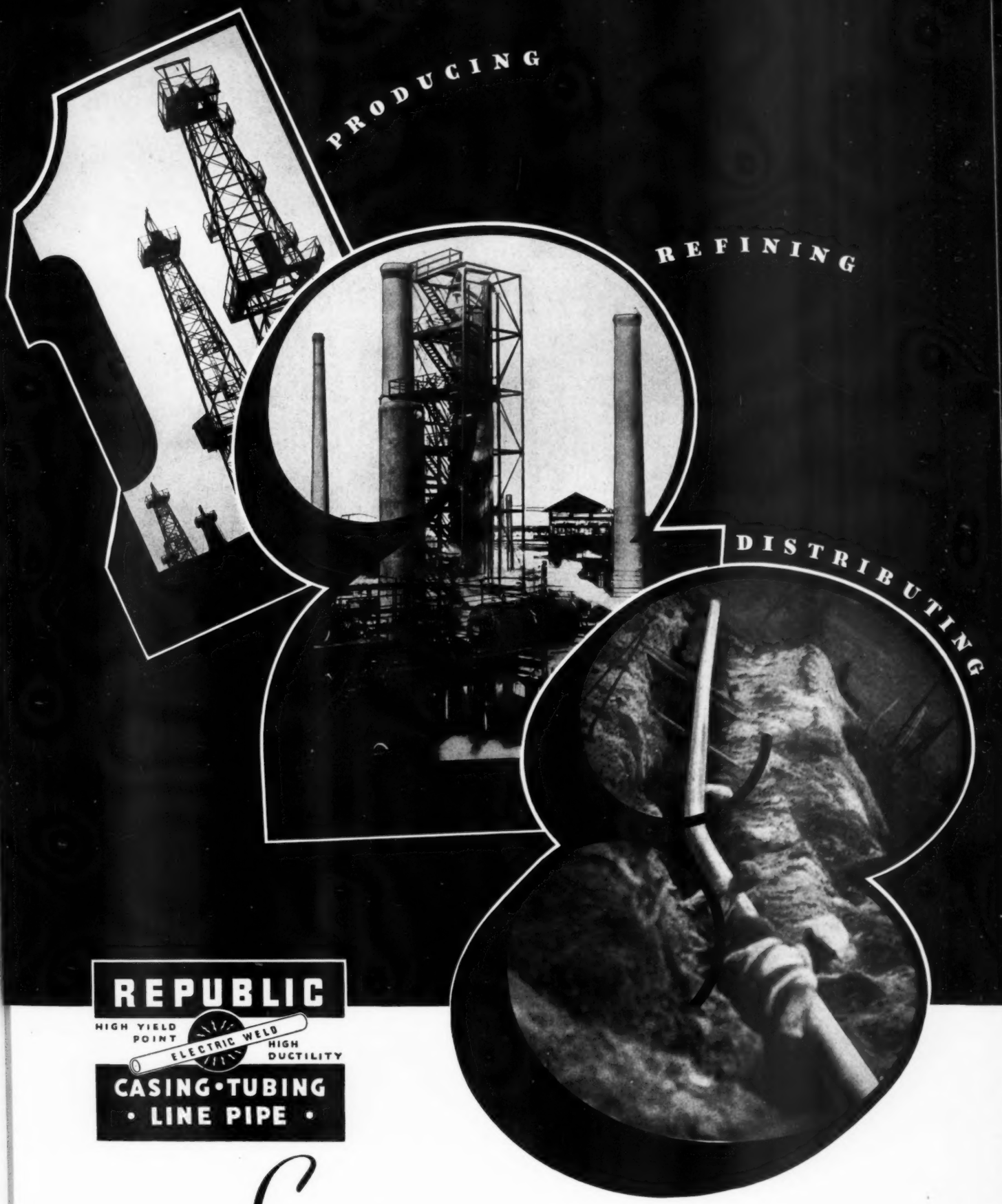
Construction of a new $50,000 Lane-Wells Company office and factory buildings in Los Angeles will be completed about March 1, it has been announced.

Two reinforced concrete units, modern in design, are being erected on a two and a half acre site on Soto Street north of Slauson Avenue in the Southern California city. The office building will be 50 ft. by 150 ft., and the factory 72 ft. by 160 ft. Both are to be earthquake-proof as well as fire-proof and will have completely air-conditioned offices.



The buildings will be jointly occupied by the Lane-Wells Company, manufacturers of gun perforators, oil well packers, and liner hangers, and the Technicraft Engineer Corporation, a subsidiary company for research and development of engineering products.

Albert E. Hansen, of Glendale, California, is the architect.



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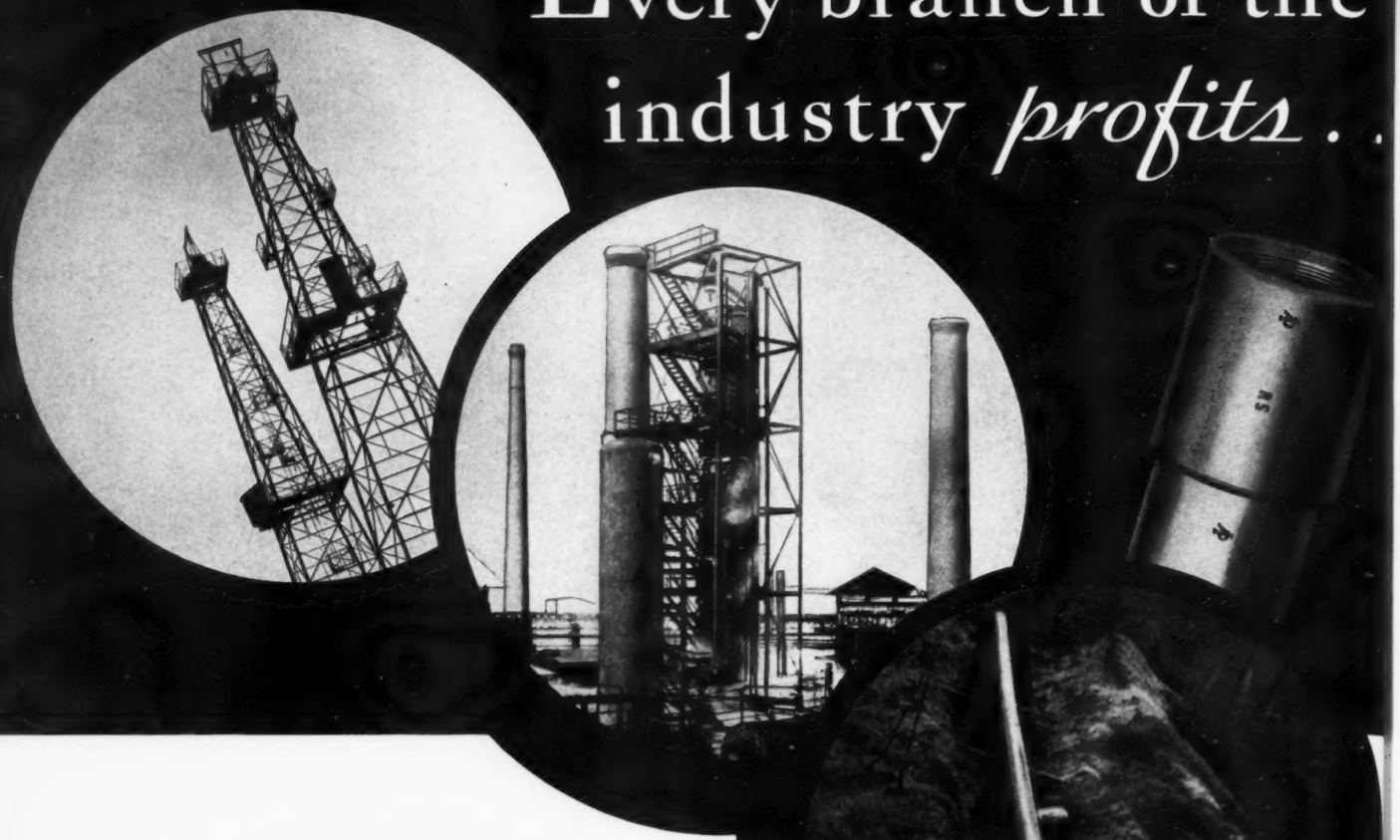

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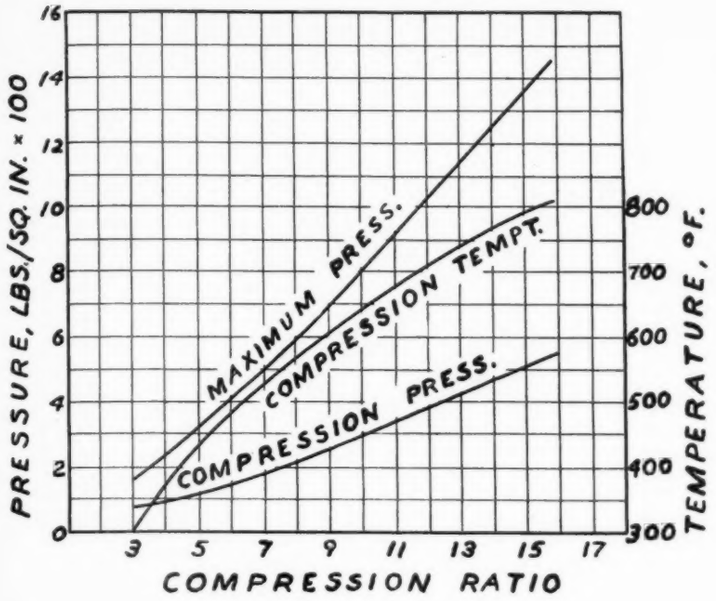

Fig. 5. Effect of compression ratio on the pressures and temperatures in the cylinder of an engine operating on the theoretical Otto cycle

By
JOSEPH LISTON

Part 2

Limiting Factors in the Actual Engine

Fundamentals of the Internal Combustion Engine

INSOFAR as our previous consideration of the Otto cycle is concerned, the higher the compression ratio the more efficient the engine, and, if, as has been stated, actual engines also give better performance at the higher ratios, the users of gas and gasoline engines well may ask why present-day engines are not built to operate at these higher ratios. The answer is that there is one major and several minor limiting conditions that prevent the use of high-compression ratios in engines operating on the Otto cycle principle.

Most important is the factor of detonation. It has been found that, in engines in which the fuel and air are mixed before or at the beginning of compression, above a certain compression ratio, varying with the design details and the type of fuel, the mixture no longer burns in the normal way but tends to explode more like dynamite. This different kind of burning is believed to be the simultaneous combustion of a considerable portion of the charge that has been heated to the spontaneous ignition temperature of the fuel vapor. It is reasonable to believe that if a charge is raised to a higher temperature before it starts to burn, the last portion of the charge normally to burn will be more likely to reach its spontaneous ignition temperature and detonate before the flame advancing from the spark plug can reach it and burn it in the normal way. Hence the increase of compression temperature with compression ratio, Fig. 5, offers one explanation of the greater tendency toward detonation at the higher compression ratios.

True enough, somewhat higher ratios than are now in current use are possible by using special knock-resistant fuels, but engine users who are considering costs must balance the increased efficiency against higher-priced fuels. When this cost factor is included, operating costs do not decrease nearly so rapidly with the higher compression ratios.

Two-Stroke and Four-Stroke Applications of the Otto Cycle

In the practical application of the Otto cycle to the actual engine certain important modifications are necessary. A number of applications of this cycle have been attempted, but so far it has proved satisfactory only in the so-called two-stroke-cycle and four-stroke-cycle engines of the conventional type now in common use.

The application of the Otto cycle principle to the two-stroke-cycle engine is illustrated in Fig. 6. The indicator shown is not a practical means of indicating the engine, but it serves to illustrate the method. The pressure-volume diagram is an actual full-load card from a two-stroke-cycle natural gas engine. Briefly, the action during the cycle is as follows:

In the position shown, the piston is moving to the left on the compression stroke, and point P on the card shows the pressure-volume conditions in the cylinder. As the piston approaches Y, the head-end dead center, P, rises to S, the point of occurrence of the spark, and then to 2, the compression pressure. In the actual engine, it is necessary to have the spark occur before the end of the compression stroke because a small interval is required for the flame to begin to spread through the mixture. From 2 to 3 the pressure rises due to the liberation of heat by the burning mixture, and from 3 to 4, during the return motion of the piston, expansion takes place.

At 4 the piston uncovers the exhaust port, and the pressure falls rapidly due to the escape of the charge to the exhaust. When the edge of the piston has reached W, it begins to uncover the inlet port, and, as soon as the pressure in the cylinder falls below the pressure on the inlet pipe, new charge begins to enter. Escape of the burned charge

through the exhaust port and entry of the new charge through the inlet port continue simultaneously until the piston reaches X, the crank-end dead center, and returns to W. Escape of the burned charge continues while the piston moves from W to Z. At Z compression begins and the cycle is repeated.

The engine is called a two-stroke-cycle type because the cycle or series of events is completed in one revolution of the crankshaft or two strokes of the piston.

Comparing the theoretical Otto cycle card, Fig. 1, with the actual two-stroke-cycle card, Fig. 6, it is seen that:

1. The pressure-rise line 2-3 is not vertical and the pressure does not rise so high in the actual card. Hence, less area (representing useful work) is enclosed in this part of the card loop.

2. Expansion is terminated before the piston has reached X by the uncovering of the exhaust port. This is necessary in order to get the new charge into and the burned charge out of the cylinder, but again there is a reduction in area of the actual card as compared to the theoretical card.

3. Compression cannot begin until the piston has reached Z. Hence, the *effective* compression ratio is $\frac{C + D_E}{C}$ and not $\frac{C + D}{C}$.

From this brief comparison of the theoretical Otto cycle card and an actual example from the two-stroke-cycle engine we may conclude that, for a given displacement and compression ratio, (1) since the area of the card is less, the actual engine will develop less power, and (2) since the effective compression ratio is reduced, the actual efficiency will be appreciably less than the theoretical. Actual performance tests with two-stroke-cycle engines have shown these conclusions to be correct.

The application of the theoretical Otto cycle to the four-stroke-cycle engine is illustrated in Fig. 7. The card, taken from a natural-gas engine, represents approximately full-load performance.

In the position shown, the piston is compressing the charge. At S, the spark occurs, the ignition timing being advanced ahead of the end of the compression stroke the same as in the two-stroke-cycle engine. From 2 to 3 the pressure rises due to the release of energy during burning. Expansion is from 3 to 4, but, when the piston has reached Z, corresponding to 4, the connecting rod is in the position F-G, and the camshaft M has rotated to where exhaust cam E is just starting to lift the cam follower N and open the exhaust valve. As soon as the exhaust valve opening provides an exit for the burned gas, the cylinder pressure starts to decrease along the line 4-4A. Then as the piston moves back from X to Y, E holds the exhaust valve open and the burned charge is pushed out of the cylinder. The pressure variation is shown on the card as line 4A-5.

By the time the piston has reached Y, cam E has moved around sufficiently to allow the exhaust valve to close, and the intake valve cam I is just starting to open the intake valve (directly behind the exhaust valve in Fig. 7). As the piston moves backward from Y to X, the intake valve is held open, and the new charge is drawn into the cylinder along the pressure-volume line 5-1. At Z, corresponding to connecting rod position F-H, cam I has moved around and allowed the intake valve to close. Then, as the piston continues toward Y, the pressure rises along the line 1-2 and the cycle is repeated.

The series of events constituting the four-stroke-cycle requires two complete revolutions of the crankshaft or four full strokes of the piston, hence the name four-stroke-cycle engine.

Comparing the theoretical Otto cycle card, Fig. 1, with the actual four-stroke-cycle card, Fig. 7, it is seen that:

1. The pressure rise line 2-3 deviates from the theoretical card line 2-3 in much the same way and for the same reasons as in the two-stroke-cycle card.

2. Expansion has ended before the piston has reached X, due to the opening of the exhaust valve.

3. A complete stroke of the piston is added to the cycle for pushing the burned charge out of the cylinder.

4. Another complete stroke of the piston is used to draw in a new charge of fuel and air.

5. Due to the necessity of reducing the cylinder pressure below atmospheric, in order to induct the new charge, the compression line does not cross the atmospheric line until after the piston has left point X. Hence the entire compression line is displaced downward, thus lowering the compression pressure. This is the equivalent of reducing the effective compression ratio. This also may be illustrated by noting that the intake valve does not close until the piston has reached Z, and, since compression cannot begin until the valves are closed, the effective compression ratio is $\frac{C + D_E}{C}$ and not $\frac{C + D}{C}$. This last applies in a general way only as it can be shown that proper valve timing will materially improve engine performance.

From this comparison

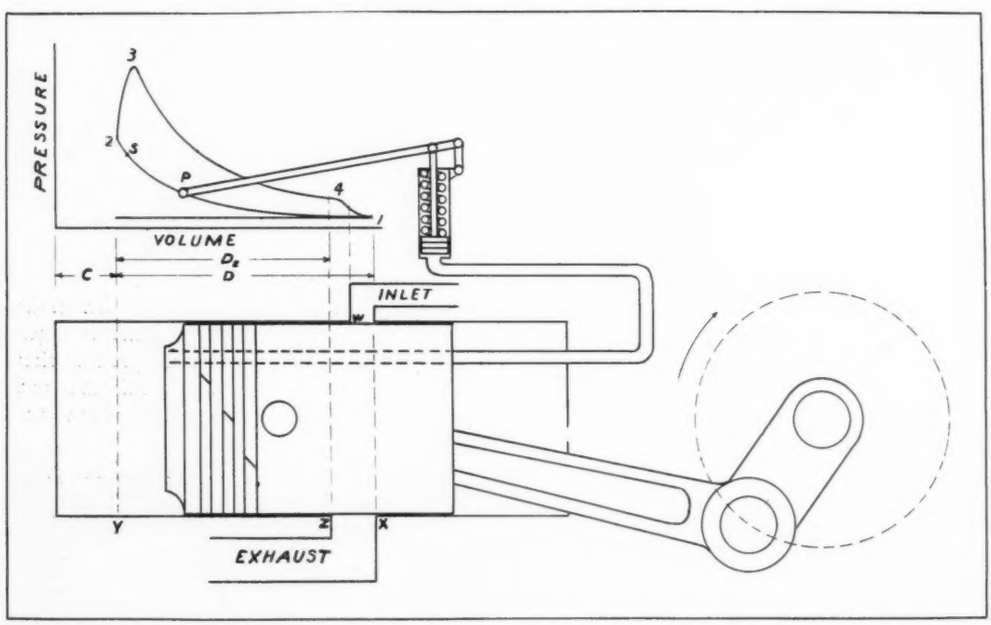

Fig. 6. An actual full-load indicator diagram or card from a two-stroke-cycle natural gas engine operating on the Otto cycle principle

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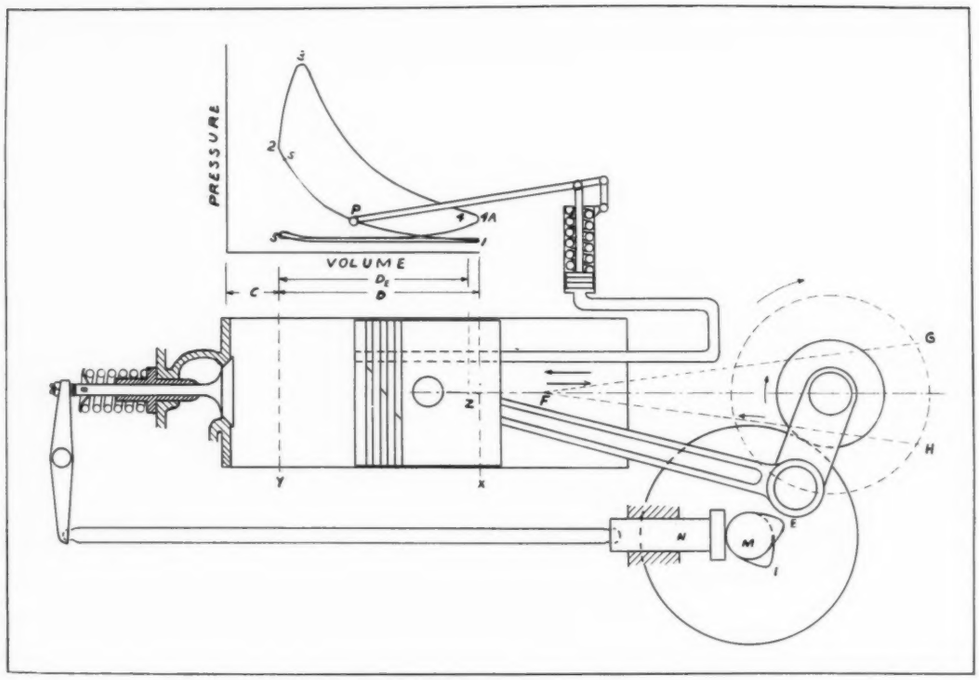


Fig. 7. An actual full-load indicator card from a four-stroke-cycle natural gas engine operating on the Otto cycle principle

of the theoretical Otto cycle and an actual application in the four-stroke-cycle engine, we may conclude that (1) the useful power developed by the actual engine will be less because the area of the card is less and also because the engine must supply power in pumping the charge into and out of the cylinder, and (2) the efficiency will be less than the theoretical efficiency because the effective compression ratio is less than the theoretical ratio. As in the case of the two-stroke-cycle engine, actual tests have proved these conclusions to be correct.

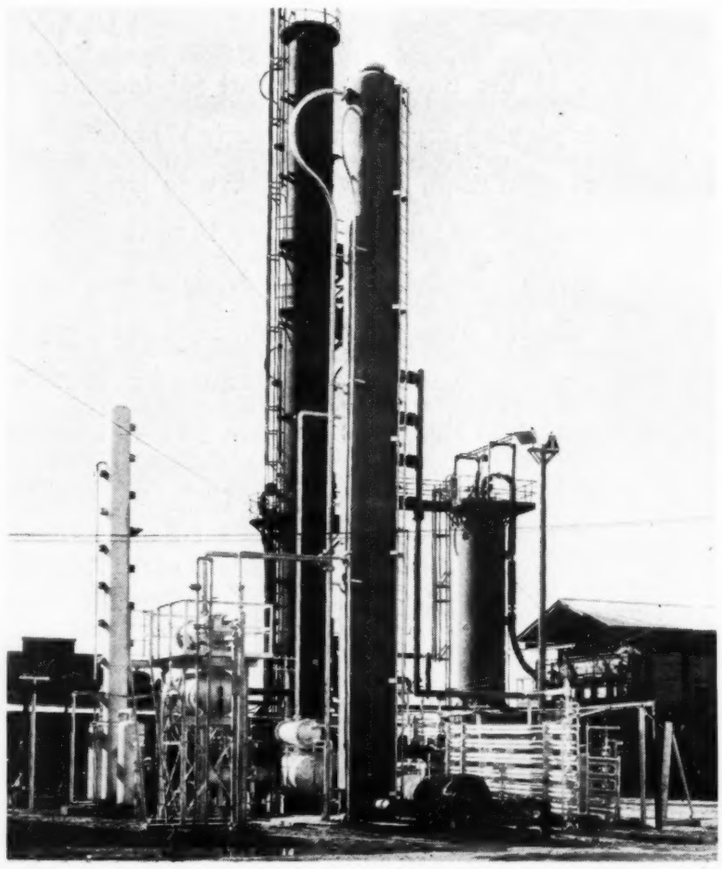
Many minor factors such as valve timing, length of induction and exhaust piping, etc., may alter the ratio of actual to theoretical performance, but actual results seldom equal the theoretical; however, this does not lessen the value of the theoretical Otto cycle as a standard of comparison in determining how well the actual gas or gasoline engine succeeds in converting heat into useful work.

Sunray Installs New Stabilizer

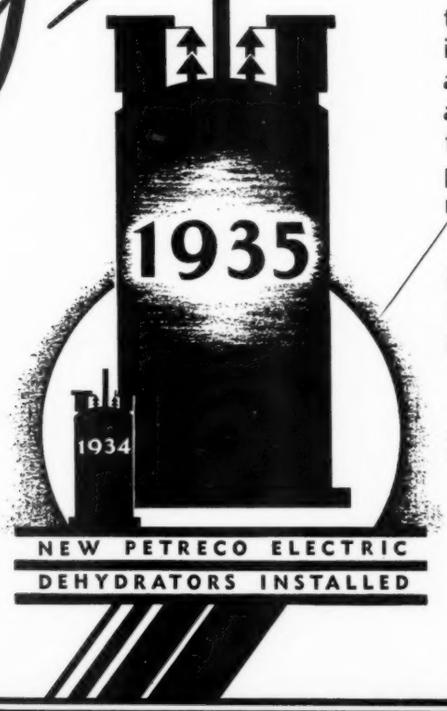
A HIGHER YIELD and a more stable product is obtained from the new pressure distillate stabilizer recently put into operation by the Sunray Oil Company at its Allen (Oklahoma) plant. This stabilizer, designed and built by the Petroleum Engineering, Inc., of Tulsa, has a capacity of 50,000 gal. per day charge of pressure distillate. The installation of this stabilizer by this company has succeeded in reducing the operating losses of the Dubbs cracking unit approximately four percent on the basis of charge.

The stabilizer not only makes a sharp cut between the propane and butane, but it practically eliminates all iso-butane from the finished product. Propane is entirely eliminated. The substituting of butane for the usual percentage of iso-butane accounts for the higher yield. The resultant stabilized product has a vapor pressure of from 7 to 12 lb., depending on the time of year.

On the basis of a four percent reduction in losses the cost of installation paid out in approximately four months.



THE *Trend* IN DEHYDRATION IS *Clearly Defined* BY THESE SUBSTANTIAL *Gains*



The turn of another year finds Petreco recording steady, substantial gains both in the number of new installations, and in the total throughput of existing plants. This fact is important to oil men because of the reasons back of it.

The Petreco process long has been the standard of excellence for treating emulsified crude. Producers always have found it a most satisfactory process for different types of emulsions—a dependable safeguard against "cut" oil losses. Through the years Petreco has conducted a relentless campaign of research and development in the laboratory and in the field, and unfailingly has anticipated changing field, well and emulsion conditions with the most advanced improvements in equipment and treating procedure. Petreco and the Petreco process have withstood the test of time in no uncertain manner.

Today, as in the past, Petreco leadership is expressed in terms of preference, and is reflected by increases in perfect step with progress within the industry.

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PETRECO

The Electrical Process for Dehydrating Crude Oil Emulsions

Leadership EXPRESSED IN *Cold Figures*

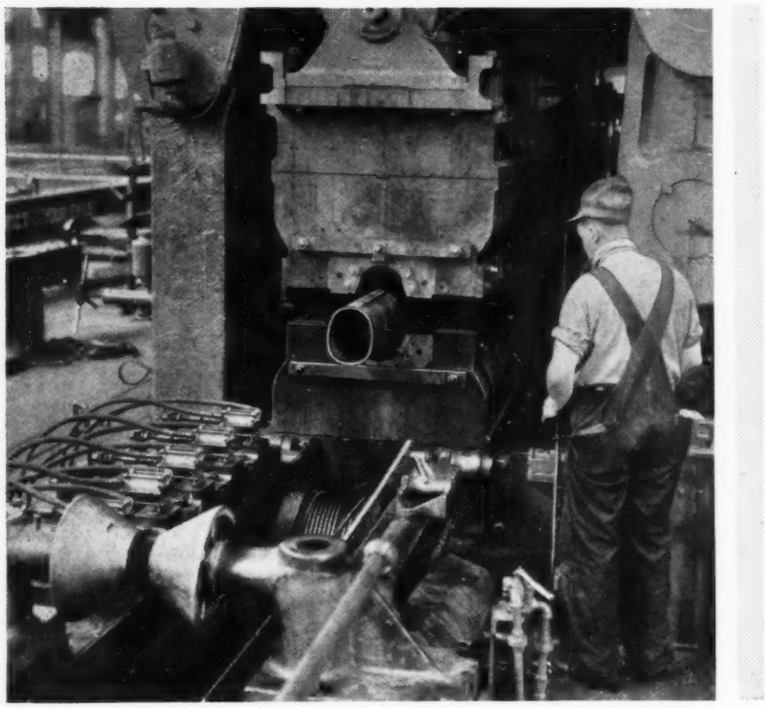
A. O. Smith High Yield Casing

SHIPMENTS of High Yield Casing, recently introduced by the A. O. Smith Corporation, have now been made to a number of oil fields in California, Texas, and New Mexico. This product, entirely new in conception, promises to be as revolutionary as Smithfield cracking stills were for oil refining and as Smithfield line pipe was for natural gas lines, the manufacturers state.

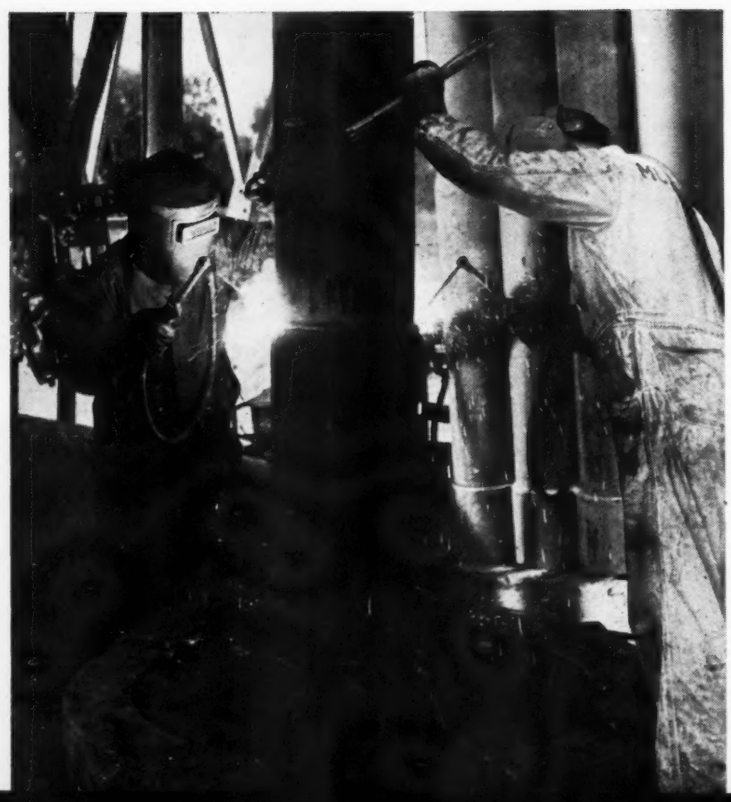
The Smith High Yield Casing is claimed to offer new advantages to the oil industry in the following three ways:

1. Permits the use of a lighter weight casing for a specified depth while maintaining the present safety factor. This results in considerable savings in both steel and freight costs.
2. Materially increases the safety factor at any specified depth without increasing the weight. This offers added insurance at no extra cost.
3. Allows greater setting depths while maintaining the present safety factor. This meets the demand brought about by the inevitable trend to still deeper wells.

Introductory strings of High Yield Casing already have been set by some of the larger producing companies, the manufacturers announce, and the new casing promises to allow the tapping of deeper oil sands with a higher safety factor than was heretofore possible.

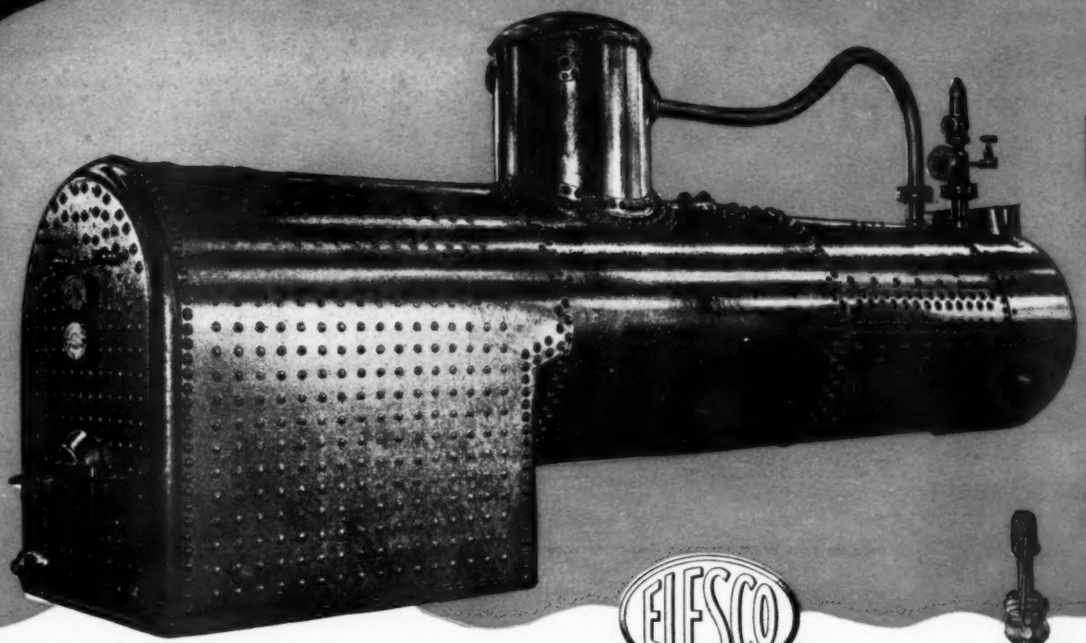


High Yield casing in the making. A length of casing enters the press (10,000 tons capacity) in which compression treatment is given



High Yield casing in the field. Welding of slip joint casing on a California derrick floor. High Yield casing also is supplied threaded and coupled

Farrar & Trefts CONTINENTAL "CODE" BOILERS with SUPERHEATERS



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THE increased tendency toward deeper drilling makes more power both necessary and advisable. Get this extra power by using Farrar & Trefts Continental "Code" Boilers with Elesco Superheaters.

Elesco Superheaters increase the capacity, speed and flexibility of the drilling rig through increasing boiler efficiency. This means less fuel consumption, less wear and tear on moving parts of the rig and a lower cost of operation for the lease.

View in Smoke Box of Superheater Boiler

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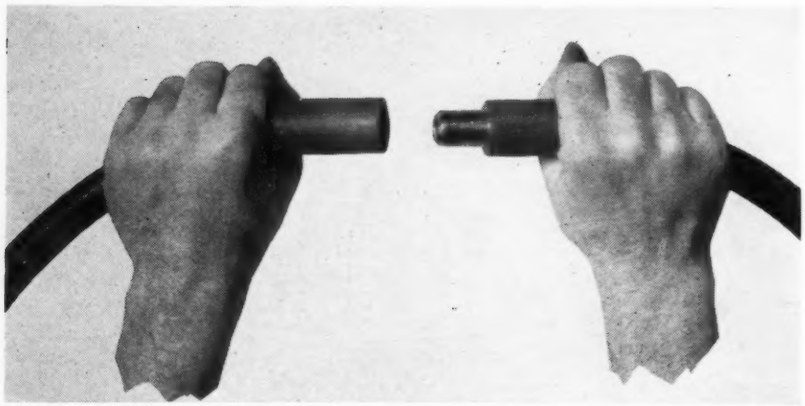


A NEW TYPE of quick-detachable connector, designed for use in connecting welding or electrode cable and which, the manufacturers state, locks in position and cannot work loose nor be accidentally pulled apart, is announced by The Lincoln Electric Company, Cleveland, Ohio.

This new connector, illustrated here, provides a quick method of connecting cables. Its operation is so simple that connection can be made in the dark.

In operating the connector, the plug is inserted in the jack and a twist of the wrist locks the connection. (See illustration.) To disconnect, the procedure is reversed.

Protection against grounding is assured by fibre insulating sleeves. It is fully described in a new bulletin on arc-welding supplies, available upon request.

Roe "Pay" Underdigger of Bridgeport Machine Co.

THE Bridgeport Machine Company of Wichita, Kansas, is now placing on the market the Roe "Pay" Underdigger, a new patented cable tool for enlarging the "pay" formation below the casing after a well has been drilled. The tool has been field tested for over two years and is said to have been used with remarkable success in both new and old wells, increasing the production in practically every instance from 15 to 200 percent.

The accompanying illustration shows the tool in operating position with the two cutters fully extended. These cutters, made of heavy, solid blocks of tough steel, are supported in the body of the tool by a socket joint at the top or shank of each cutter. The cutters are folded into the body of the tool, riding the pipe to the bottom. As the tool goes out of the pipe into the open hole, a heavy spring, controlling a cross bar, forces the face of the cutters out to operating position, where they are firmly seated on three points of the body.

A shoulder may be formed and the tool started at any desired point below the casing, a special set of starting cutters being furnished for this purpose. Then by the use of cutters of various sizes, the hole may be enlarged as desired, up to more than double the size of the drilled hole, or as little as one inch at a time. It is run in practically the same manner as an underreamer, the broad cutters digging out the sides of the hole. It may be used in either hard or soft formations.

When the production from new wells is obtained from lime formations, the size of the hole in the "pay" may be more than doubled by underdigging so that the chemicals used in acidizing may have twice the wall surface on which to work. In new sand wells, the size of the hole in the "pay" may be increased in size as desired, up to the maximum expansion of the tool, to allow a more rapid flow of oil into the hole. Outstanding results are said to have been obtained in increasing production in old wells where the walls of the hole in the "pay" formation have become corroded with paraffin and other obstructions. In these wells, a small amount may be taken off the walls and the size of the hole in the producing horizon increased by small amounts at several succeeding operations, keeping the walls of the hole in the "pay" clean for an indefinite length of time, the manufacturers state.

The tool also is used for many other purposes besides underdigging the "pay", including enlarging the hole before cementing for a better distribution of cement around the casing shoe; to enlarge the hole in a water strata between two oil producing formations so that the water may be cemented off; to remove knots from the walls of a hole that interfere with lowering casing or bailer; to straighten crooked holes; to enlarge tight places in a hole; to make a shoulder at any point below the casing to start an underreamer before raising the casing; to make a shoulder to start drilling-by or side-tracking lost tools; to make a starting shoulder to straighten a crooked hole; to remove cement from the walls of the "pay" formation after the oil string has been cemented, etc.

Patents, manufacturing and distributing rights are controlled exclusively by Bridgeport, who will distribute and rent it through their branch stores and distributing connections.

G-E Electric Thickness Gauge

A NEW electric gauze, developed for measuring the thickness of porcelain enamel, paint, or other nonmagnetic materials that have been applied to or laid on flat sheets or plates of steel or iron, has been introduced by the General Electric Company, Schenectady, New York. It permits quick and convenient measurement of the thickness of the material not only at the edges but in the middle or any other place where a flat surface slightly more than an inch in

diameter can be found. Weighing only 7½ lbs. complete, it can be used portably wherever a 110-volt, 60-cycle power supply is available.

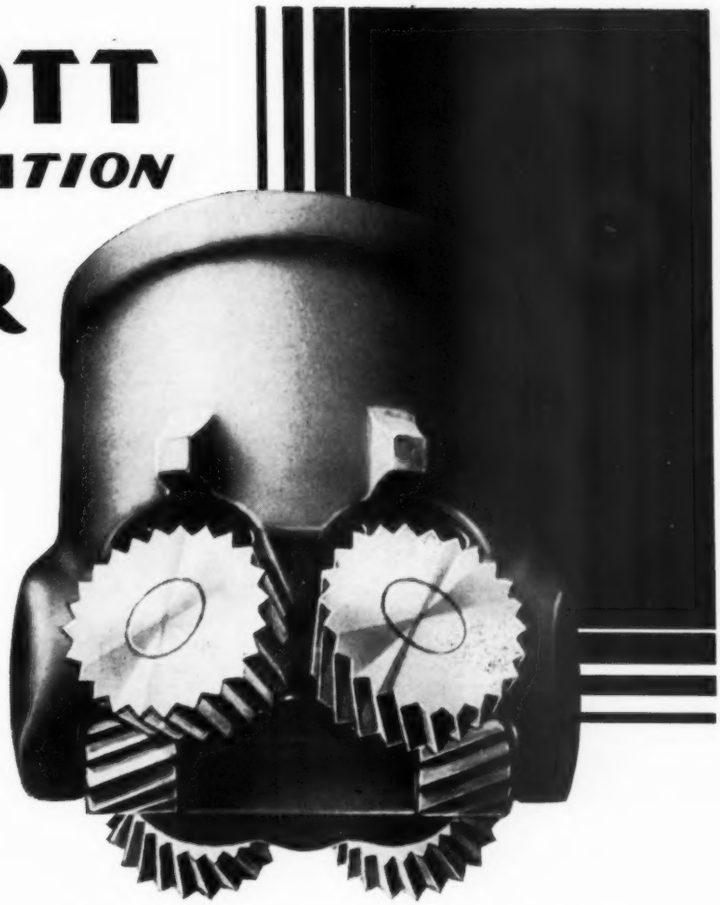
The new instrument consists of a small indicating unit enclosed in a neat cast-aluminum cabinet and a ½-lb. gauge head connected to the unit by cable. When the face of the gauge head is held in contact with the surface of the material to be measured, the thickness can be read directly on an indicating instrument mounted on the front of the cabinet. Because of its light weight, the gauge head can be moved readily to any point on the surface and the corresponding measurement conveniently taken.

Operation of the gauge is based upon the reluctance of a magnetic circuit passing through a coil in the gauge head and through the steel directly under the portion of the material upon which the gauge head is placed. Since the greater part of this reluctance is produced by the magnetic material (or equivalent air gap), the indication obtained is dependent upon the thickness of material being measured and can be read directly from the indicating instrument.

In use, the indicating instrument is first adjusted to read correctly with a known thickness of insulating material or a known air gap between the gauge head and a sheet of steel of the same kind and of approximately the same thickness as that used with the material being measured. It can then be used to indicate the thickness of enamel within the range for which it has been set.

Thickness ranges of 1 to 5, 2 to 10, 5 to 25, 10 to 50, and 20 to 100 mils can be obtained. A separate scale on the indicating instrument is required for each thickness range. Either single- or double-range indicating units are available, the latter combining any two of the standard ranges. For measuring the thickness of nonmagnetic metal platings on steel, and of other materials of less than one mil in thickness, a unit of modified design can be obtained.

THE ELLIOTT HARD FORMATION CUTTER HEAD



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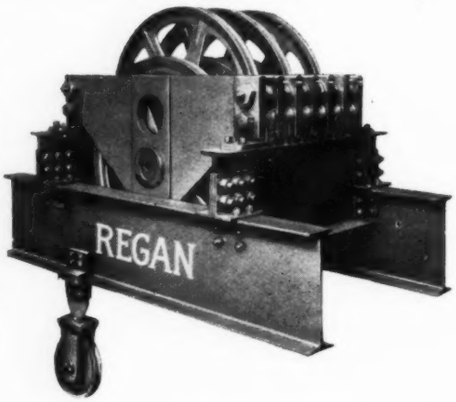
Regan Straight-In-Line Crown Block

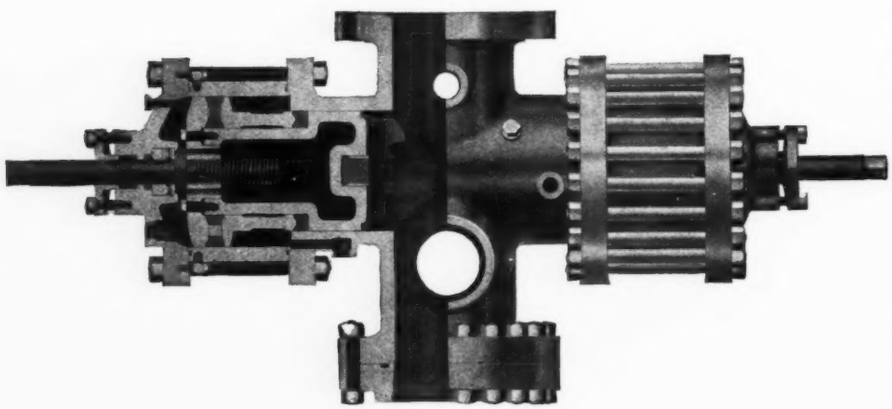
A NEW type crown block with single-deck, welded construction, and equipped with dual staggered bearings, is announced by the Regan Forge and Engineering Company of San Pedro, California. It was designed primarily as a companion for the Regan 76-in. traveling block. It is equipped with six 48-in. or 60-in. sheaves. The capacity is 360 and 500 tons, respectively. This crown block is known as Type E. Literature is available upon request.



Type "SDA" Blowout Preventer of Cameron Iron Works

CAMERON Iron Works, Inc., Houston, Texas, announces that it is now making deliveries on Type "SDA" (short double-acting) pressure operated blowout preventers, claimed to be the latest development in the field of ram-type blowout preventers.

The new preventer instantly and positively seals the annular space between the casing and drill pipe during drilling operations, or between casing and any other pipe that may be run in the hole, the manufacturers state. Due to the design of the new ram-packing element, seal is so positive that drill pipe may be rotated and raised and lowered through the closed rams for a long period of hours to prevent sticking while circulating to regain control of a well. The new ram-packing element consists of a solid moulded block of special resilient material, supported on its upper and lower faces by substantial steel plates, as illustrated. When snapped into place in the rams, where it is securely held by steel dowel locking pins moulded integral with the packing, the packing element and supporting plates project beyond the face of the ram approximately $\frac{1}{8}$ inch. The resilient packing material is entirely confined by steel, except on the surface that contacts the pipe. In this manner, a reservoir of packing material that feeds automatically as needed is incorporated in each ram. When rams are closed around the pipe by pressure, the metal plates of the moulded packing in opposing rams contact each other, and the resilient material is then entirely confined by steel. Upon application of further pressure (fluid or manual) the resilient packing tends to flow to the pipe, thereby effecting a positive, leakproof shut-off. Wear on packing is automatically taken up by the new packing element, and a pressure-tight seal is assured even on irregular, worn, or undersized pipe it is stated.



In addition to the new packing element with which they are fitted, rams of the Type "SDA" preventer automatically center the pipe to be sealed, no matter how much it is hanging off vertical; they are longer than previous Cameron rams and can safely support long strings of pipe; they are extremely free-acting, insuring against sticking and simplifying ram-changing in the field; they are fitted with shorter, heavier ram-locking screws. Design of the "SDA" ram piston permits use of a shorter pressure cylinder, substantially reducing overall length of the preventer and making handling easier. Rams are opened and closed instantly by fluid pressure. The large ram piston diameter provides a 3-to-1 pressure ratio, that is, 500 lb. fluid pressure will hold 1500 lb. well pressure without application of the ram-locking screws. Ram and ram piston assembly are very simple, making ram changes in the field quick and easy. Interchangeable rams permit safe handling of almost any size pipe that can be run through the casing on which the preventer is installed.

Cameron "SDA" preventers are available either with single flange for flanging to casing and with female casing thread on top, or with double flange for flanging a drilling-through gate to the top of the preventer. Type "SDA" preventers are supplied in all popular sizes. Complete details may be had by writing to the Cameron Iron Works, Inc., Houston, Texas.

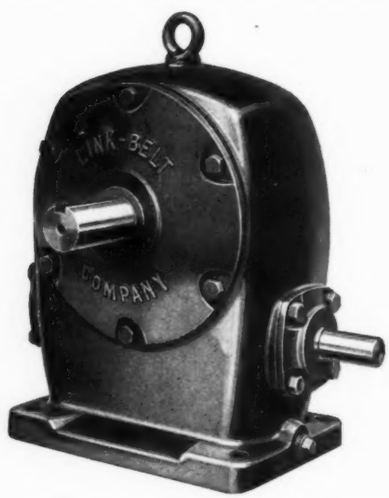
Worm Gear Reducers Announced by Link-Belt

ANNOUNCEMENT is made by Link-Belt Company, Philadelphia, that it has developed and is now in production on a new line of cut-tooth worm gear speed reducers of simple, compact, accessible construction, offering great flexibility of driving arrangement.

The new reducers are available in a wide range of ratios and capacities, with single or double reduction, and in horizontal and vertical types; all provided with precision-tapered roller bearing and automatic lubrication within dust-proof gray iron housings.

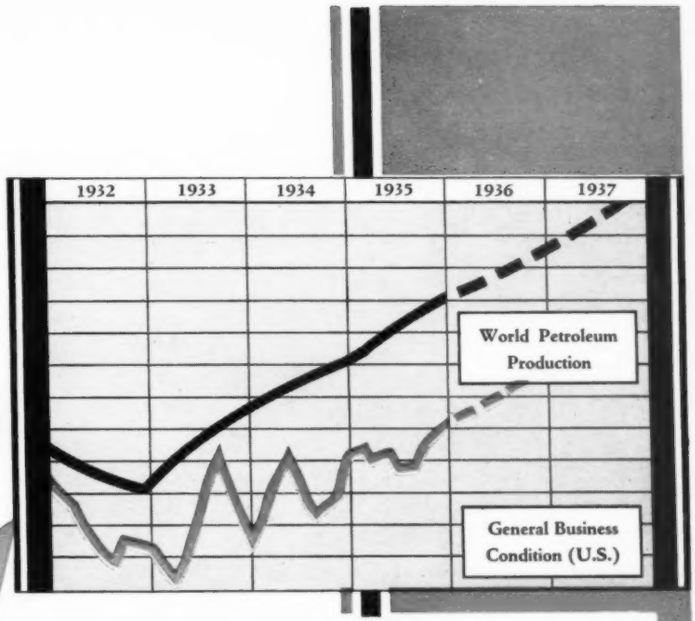
The output shaft with its chilled phosphor bronze worm wheel can be placed above or below the worm shaft, made of a low-carbon alloy-steel forging, carburized and heat-treated after the worm threads have been cut thereon. A feature of the double-reduction reducer is the unitized attachment of primary reduction unit to the side of final-reduction housing.

Conforming with the recently recommended practice of the American Gear Manufacturers' Association, the name plate of each Link-Belt worm reducer is stamped to indicate the ratio, input and output r.p.m., the input hp., or output torque capacity, and the service factor used in determining the rating for which the unit has been sold.



A 40-page illustrated catalog, No. 1524, has been prepared, giving dimensions, service factors, A.G.M.A. hp. ratings, and engineering data for selection of the right reducer unit. This book will be sent to any reader upon request addressed to the company at 2045 West Hunting Park Avenue, Philadelphia, Pennsylvania, or nearest office.

FOR *Safely* DRILLING OIL WELLS TO *Any Depth*



The petroleum industry is entering a new era according to the concensus of authoritative opinion. We have every reason to enter this period with the utmost optimism and confidence.

The Emsco line will occupy an important position in the progressive petroleum development of this new era. It is the most complete line of advanced drilling and production equipment in Emsco history. It will make possible the drilling of oil wells to unprecedented depths—to whatever depths may be required—safely, efficiently and economically.

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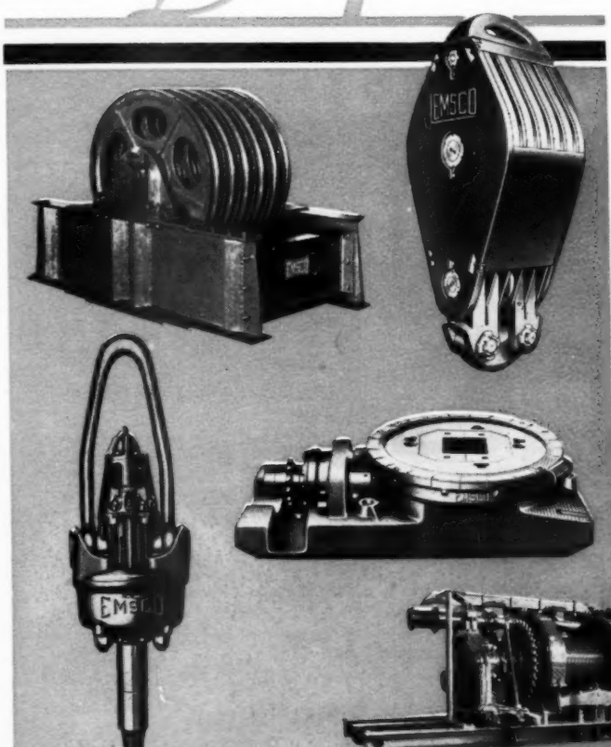
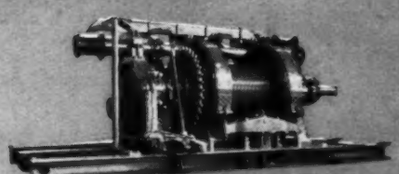
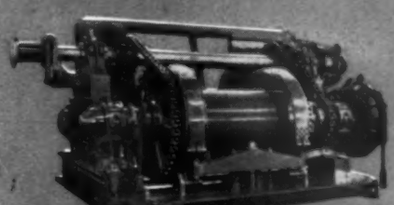


EMSCO
A Complete Line of Better Oil Well Equipment



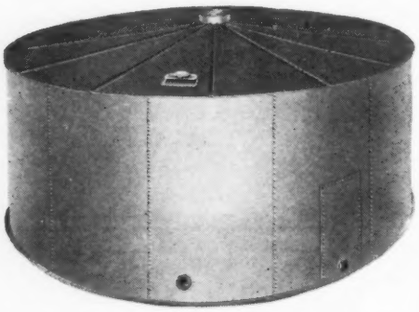


EMSCO

Maloney Announces Galvanized Tanks

THE Maloney Tank Manufacturing Company, of Tulsa, Oklahoma, has announced that Maloney bolted steel tanks of all standard A.P.I. sizes may now be ordered with a special heavy galvanized coating, for added resistance to corrosion.

Maloney galvanized tanks, it is stated, are standard Maloney tanks of Keystone copper steel, hot-dip galvanized after fabrication. Galvanizing is being done at the new West Tulsa plant of the Rogers Galvanizing Company. Sheets and other parts



are first given a prolonged bath in muriatic acid solution to prepare the surfaces for bonding tightly with the zinc coating. Virgin zinc 99.9 percent pure is then applied by the hot-dip process, the spelter weighing five lb. to 100 lb. of steel coated. It is stated that galvanizing after fabrication avoids injury to the galvanized coating, as well as galvanizing all edges of sheets including bolt holes. Finished coatings are said to be of highest standard, withstanding the severe Preece test of six one-minute dips in copper sulphate solution.

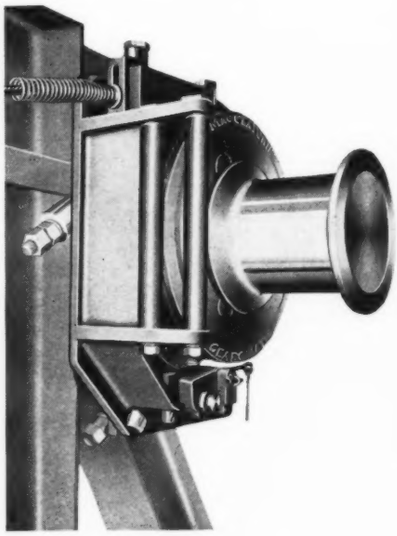
Special hot-dip galvanized bolts of 90,000 lb. tensile strength are used with these galvanized tanks.

The Rogers Galvanizing Company has just completed its modern West Tulsa plant. This is the company's fourth plant. Mr. Rogers has been in the galvanizing business for 45 years, his other plants being at Rockford, Batavia, and Blue Island, Illinois.

MacClatchie Gearomatic Cathead

MACCLATCHIE Manufacturing Company, Compton, California, has developed an automatic cathead that operates on a new principle. According to the makers it gives twice the power at half the speed, breaking the tightest joints with ease and without damage to tongs, tong dies, pipe or other equipment, and is simple and safe in operation.

The sheave for the tong line is driven by planetary gearing. When the device is inoperative the planet gears rotate on their axes and also revolve around the sun gear, which is driven by the line-shaft, so that the sheave remains stationary. When a joint is to be broken the planet gears continue to turn on their axes but are prevented from revolving around the sun gear, so that the sheave is rotated by the line-shaft through a slow but powerful driving connection. When the sheave has made one revolution an automatic kickout releases the planet gears so that they are again free to re-



volve around the sun gear. The driving connection is thus disengaged and the friction of the gearing returns the sheave to its original position where it again remains stationary in its inoperative position. There is no friction clutch or large, costly bearings, and the entire cathead is lubricated from one Alemite nipple, the manufacturers state.

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License is hereby granted to the purchaser of the Borium herein contained, according to the processes and claims disclosed in patents No. 1,757,601 and 1,803,875. —STOODY COMPANY

LOOK FOR THE LABEL

Announcing a new shape metal that is tough and not so hard as Borium. Cobalt Borium is intended for use where toughness is required rather than extreme hardness. In addition to new labels, Cobalt Borium is readily distinguished from standard Borium by the new half round and flat shapes designated as Shapes Nos. 10, 11 and 12. Ask your Stoody distributor about the new Cobalt Borium Shapes; or write the factory direct.

STOODY COMPANY WHITTIER, CALIFORNIA

Welding Rods *Alloy Steels* *Equipment*

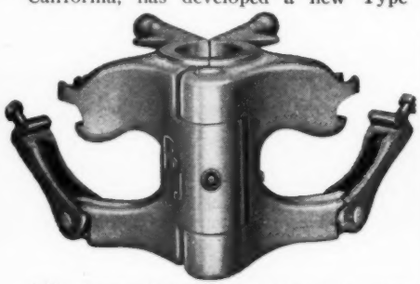
Improved Youngstown Safety Limit Stops

FOR use as a safety device in preventing overhoisting accidents on overhead traveling cranes and other applications where positive protection against overtravel is essential, The Electric Controller and Manufacturing Company, 2735 East 79th Street, Cleveland, Ohio, announces the improved Youngstown

Safety Limit Stop. This limit stop is of the main motor circuit type, handling motor currents directly without the aid of additional equipment. When the limit stop is tripped, it not only disconnects the motor from the power line but also brings the motor to rest quickly with minimum drift, the manufacturers state.

Byron Jackson Drill Pipe Elevator

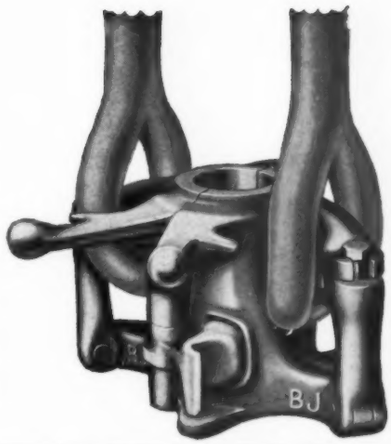
WITH recent improvements made to provide faster and more convenient operation, Byron Jackson Company of 2150 East Slauson Avenue, Los Angeles, California, has developed a new Type



"A" Center Latch Drill Pipe Elevator. Including the basic features of earlier types, this new design will accommodate all sizes of BJ Weldless Links and thus gives ample strength for handling the longest and heaviest strings of drill pipe, the manufacturers state.

New style link retainers form a part of the elevator and cannot be lost. When open, the link retainer blocks are supported at the correct angle to guide the links into position. When closed, the link retainers not only hold the links securely in position but also form a closed C-link for greater strength. The link retainer bolt screws down into a recess and is safe from accidental opening; the lower end of the bolt is peened over to prevent loss or accidental dropping in the derrick.

Additional safety is provided by the latch mechanism. Recessed in the body of the elevator, this mechanism is far to the front and is safe against possible contact with the links. It is protected against accidental opening, and since the latch handle is further protected during lowering by a guard at the bottom of the elevator it is always in a convenient position for handling. Long horns provide a large, safe grip and the guards prevent injury to the hands of the operator when large diameter links are used. When open, the elevator hangs in correct position for fast, safe, and effortless closing.



Built to "TAKE IT"

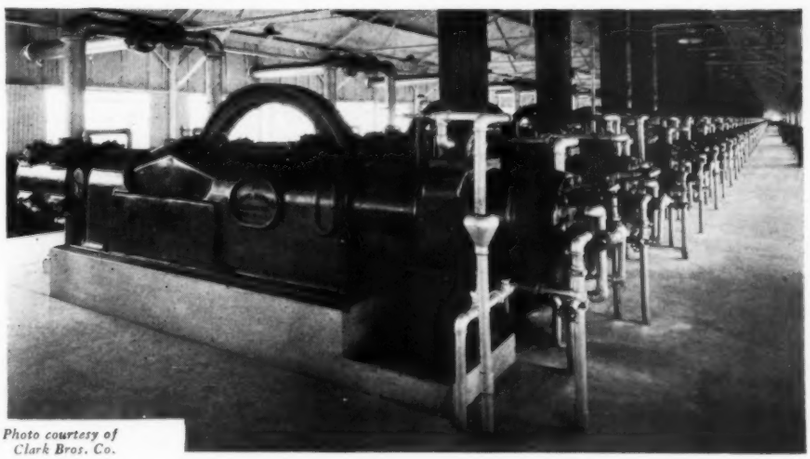


Photo courtesy of Clark Bros. Co.

they come fitted with

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The selection of Cook's Graphitic Iron Piston Rings for the popular Clark's Gas Engine Driven Compressors adds further evidence of the widespread recognition of Cook's Rings superiority — for wherever you look throughout the Oil and Gas fields, you will find Cook's Rings predominate on the important jobs because of the operating economies they effect — reduced cylinder wear — added years of engine life — fewer shut-downs for repairs. You, too, can obtain these economies by specifying Cook's Rings on your next order. Ask for brochure explaining the advantages of Cook's Rings resulting from their exclusive material — Cook's Graphitic Iron. Write today.

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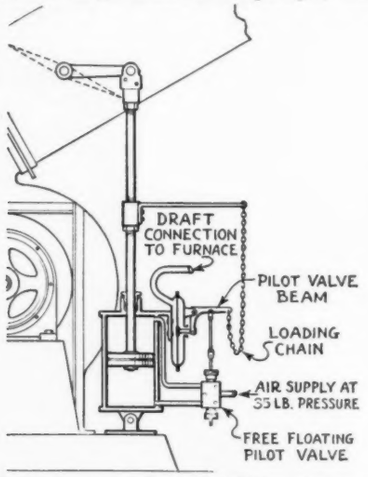
Draft Controller Functions Independently

A COMPLETE self-contained furnace draft controller requiring only a draft connection to the furnace and a supply of compressed air at approximately 35 lb. pressure has been developed by Bailey Meter Company, Cleveland, Ohio.

This controller measures furnace draft with a large sensitive diaphragm, the



Diagrammatic Drawing of Bailey Furnace Draft Controller

movement of which actuates an air pilot valve admitting pressure to one end or the other of a drive cylinder until the damper position or fan speed has been changed sufficiently to restore furnace draft to the desired value.

For example, in the accompanying diagrammatic illustration, an increase in furnace draft and a corresponding slight movement of the diaphragm to the left, moves the pilot stem downward, admitting pressure under the piston, which in turn moves upward and opens the damper. This movement diminishes the weight of chain supported by the pilot valve beam until the diaphragm force is exactly balanced and the pilot valve is returned to its neutral position. The chain loading device provides a simple and accurate means of applying a counter force against the diaphragm which is finely graduated with the movement of the control drive. When this counter force exactly balances the force produced by the furnace draft on the diaphragm, no further movement of the controller occurs.

The Bailey draft controller may be applied either to the forced draft or the uptake draft as desired. It functions independently of other control equipment, requiring only compressed air and a draft connection to the furnace.

Ditcher Powered By Diesel Engine

PRODUCTION of a new Diesel-powered trench excavator is announced by the Parsons Company, Newton, Iowa, manufacturers of a complete li..e of this type of machinery. This machine is known as Model No. 48.

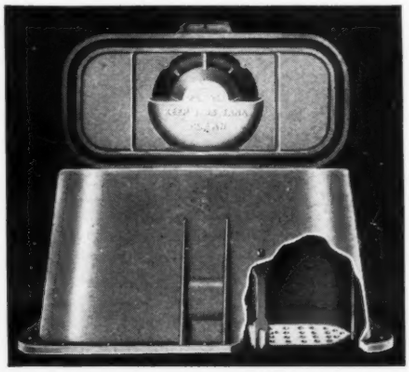
The new product is powered with a 102-hp., 6-cylinder "Caterpillar" Diesel engine, and has a capacity of 300 cu. ft. per minute. The ditcher also is available with three- and four-cylinder Diesel engines of the same make.

The Diesel excavator is especially adapted to the digging of deep trenches, it is stated. Standard digging equipment is for 18 ft. depth and 48 in. width, but attachments enable it to dig wider and deeper. The machine is semi-crawler mounted, and the drive sprocket shaft is fitted with a differential gear permitting the outfit to steer readily under working or traveling conditions.

The conveyor is of the reversible type and can load at either side if so required. Twelve digging speeds are provided, through simple sprocket changes. Total weight of Model No. 48 is 60,000 pounds.

Valve and Thief-Hatch for Water-Seal Tanks

A VALVE and thief-hatch that is said to need no iron collar, avoids waste of oil and drippings on the roof, and eliminates fire hazards from sparks has been designed for water-seal wood tanks by the Enardo Manufacturing Company of Tulsa, Oklahoma.



It is an all-aluminum vacuum-pressure type made in both round and long models. A tall 10-in. base was developed in order that it not be necessary to build an iron base. The double width opening on the long type permits a rest for the thief inside the opening, avoiding waste of oil and drippings on the roof.

The Enardo "vacuum-pressure" valve and thief-hatch has long been standard equipment on tanks made by many leading tank manufacturers, it is pointed out. The vacuum and pressure are controlled by weight of the metal. The valve has no springs, is non-magnetic, will not produce a spark when struck by metal, and is rust resistant, the manufacturers state.

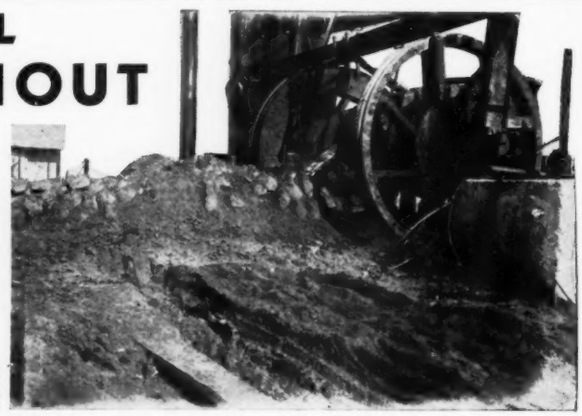
The valve is equipped with a felt-backed, gasoline- and oil-proof cork-fibre gasket. The gasket is in the lid and so arranged that ice and dirt will not gather on the fibre, thus holding the valve open or freezing it shut.

The thief-hatch opening on the round model is eight in. in diameter and the long model is 7¾ in. by 17½ in. The vacuum valve inside the lid is 5½ in in diameter and is sufficiently large to take care of normal breathing on tanks for which it was designed.

Valves are furnished for a one-half ounce vacuum and a pressure of two ounces or any other specifications needed.

A REAL CLEANOUT JOB

BY THE CAVINS



All the sand back of the bull wheel in the above unretouched illustration (and more) was bailed out of one well by The Cavins. Close inspection will disclose the wheel tracks of trucks which already have hauled away a portion of the sand.

Ordinary sand can be cleaned out of a well with The Cavins in about one-third the time required by other methods. The Cavins also breaks the hardest packed sand bridges; cleans out sand around and inside of "fish" lost in the hole; cleans out sand-bridged tubing; cleans the perforations thoroughly; and recovers cuttings, millings, and junk of every description.

The Cavins is the fastest, most efficient method of cleaning out wells. Operators make money every time it is used. Write for complete information and performance records.

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Oklahoma City, Okla. Phone 3-6441
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Lyons, Kansas Phone 227

Bottom-Hole Pressure Gauge

HIGHER standards of accuracy in bottom-hole pressure measurement are made possible with the new Stupakoff bottom-hole pressure gauge, manufactured by the Stupakoff Laboratories, Pittsburgh, Pennsylvania, according to an announcement by that company. This instrument will give a permanent record of these pressures accurate to 0.2 percent, equal to three lb. on a 1500 lb. well, it is stated. Crude oil pressure is transmitted through a series of bellows and measurements are recorded on a revolving aluminum chart. In the Stupakoff gauge the total energy available is said to be considerably greater than hitherto attainable, varying from 150 to 450 in-lb., permitting sturdy mechanical construction without losses due to friction drag. This, together with other design features, results in a guaranteed accuracy of 0.2 percent.

The Stupakoff bottom-hole pressure gauge is made in five sections. The top section need be opened only to attach or release the lifting wire. The second section houses maximum temperature thermometer that is used for correcting the chart readings. The third section contains the clock-work used to revolve the chart. The upper section of this joint is the only one that needs to be repeatedly opened, as it gives access to both the clock and thermometer.

Two types are available: indicating and recording. For the recording type, a special comparator microscope has been designed for the purpose of accurately reading the pressure record scratched on the aluminum chart.

Overall length of the instrument is 60 in.; outside diameter, 1¾ in.; weight, 35 pounds. Separate instruments are made for maximum pressure of 1000 lb., 1500 lb., 2000 lb., and 3000 lb.

For further details and literature write Stupakoff Laboratories, Oil Equipment Division, 6627 Hamilton Avenue, Pittsburgh, Pennsylvania.

Lincoln Announces Electrode For Welding 25-12 Stainless Steels

A NEW arc-welding electrode for welding the group of stainless steels belonging to the 25-12 variety is announced by research engineers of The Lincoln Electric Company, Cleveland, Ohio. Because of its higher chrome content the new electrode is particularly advantageous for welding stainless clad steels, it is stated.

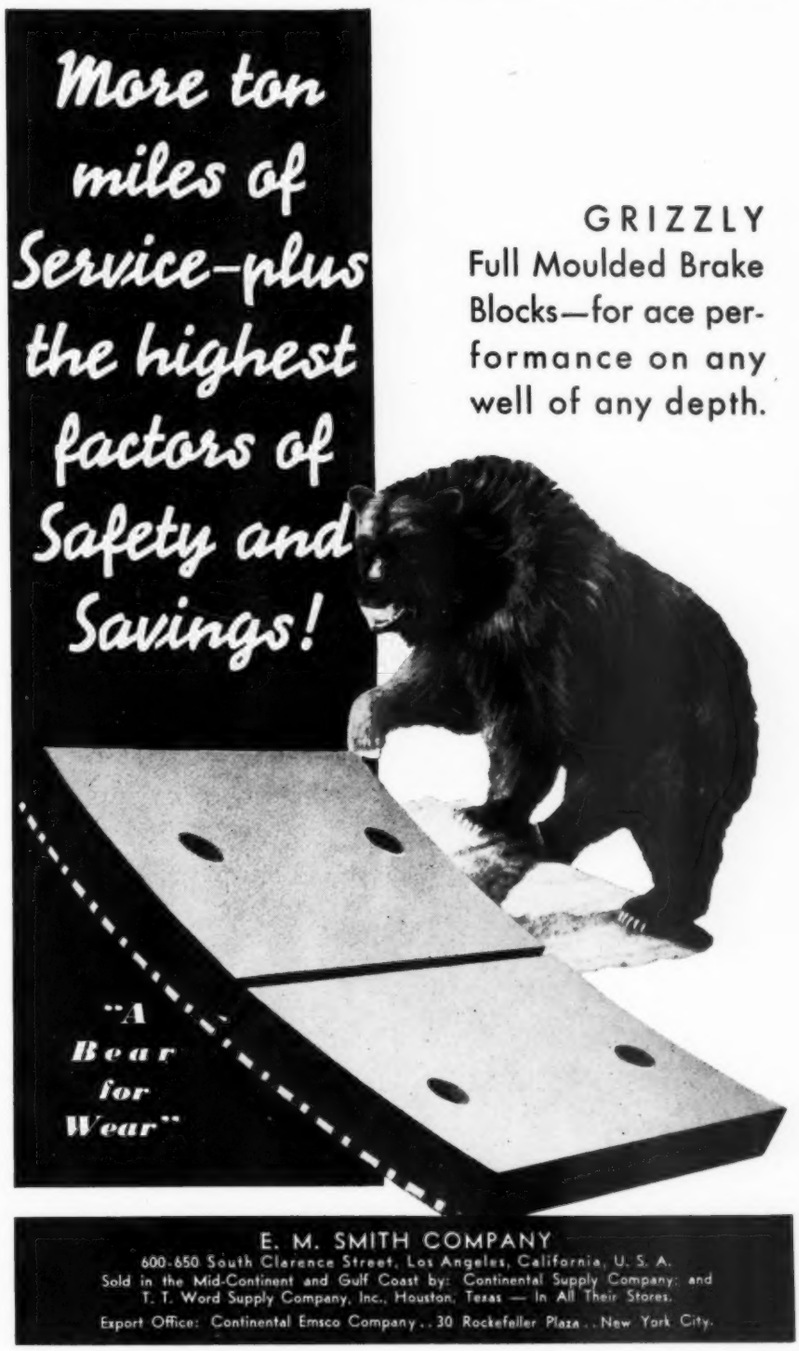
This new electrode, known as "Stainweld B", provides weld metal of the same characteristics as steel containing 25 percent chromium and 12 percent nickel. The weld metal provided by the electrode has the high-corrosion resistance, high-tensile strength, and ductility possessed by the 25-12 alloy steels, the manufacturers state.

"Stainweld B" electrode is heavily coated, utilizing the shielded arc principle of producing welds free from oxides and nitrides, brittleness, and porosity. The quality of the weld metal produced is shown in results of tensile strength and accelerated corrosion tests. Tensile strength tests show that "Stainweld B" weld metal resists a stress of 95,000 lb. per sq. inch. Test coupons broke under this stress after the area of the weld metal had been reduced to make the failure come in the weld.

The deposited metal from "Stainweld B" possesses the same resistance to corrosion as 25-12 plate.

In addition to possessing high-tensile strength and unusual resistance to corrosion, "Stainweld B" weld metal has high ductility and is exceptionally resistant to abrasion, it is pointed out; moreover, the "Stainweld B" deposit maintains these physical properties at high temperatures. Scaling is reduced to a minimum for this type of material.

"Stainweld B" electrode, together with the well known Lincoln "Stainweld A" for 18-8 stainless steels, now makes it possible to arc-weld practically any of the more extensively used stainless alloys, the makers say. "Stainweld B" is available in $\frac{3}{32}$-in. and $\frac{1}{8}$-in. sizes in 11-in. lengths. It comes packed in 15-lb. containers in the $\frac{3}{32}$-in. size and in 10-lb. containers for the $\frac{1}{8}$-in. size.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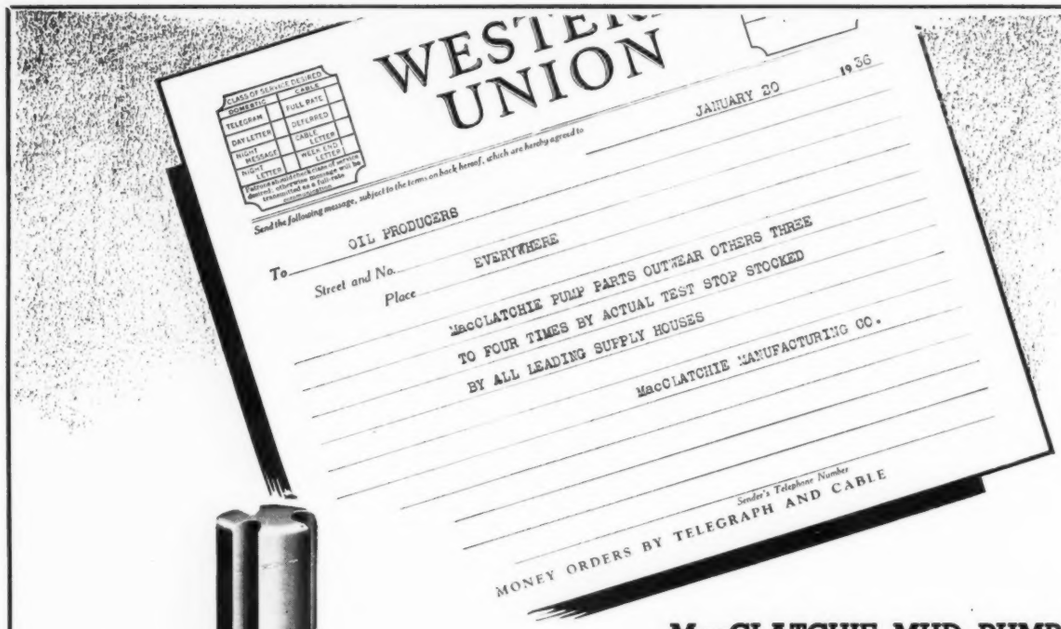
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JANUARY 20 1936
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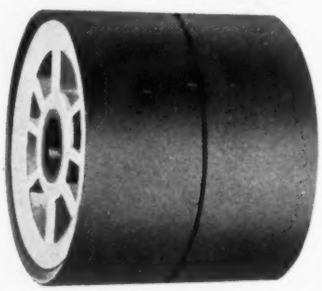
MacCLATCHIE MANUFACTURING CO.
Sender's Telephone Number
MONEY ORDERS BY TELEGRAPH AND CABLE

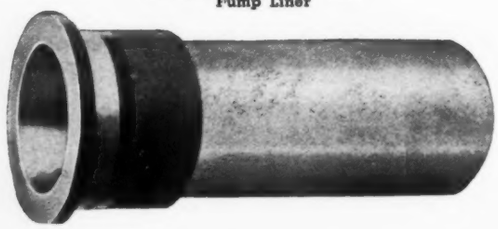
MacClatchie Mud Pump Valve

MacCatchie "Wearever" Piston



MacClatchie "Special Taper" Rod

MacClatchie "Money Saver" Pump Liner



See the **COMPOSITE CATALOG**

The complete line of MacClatchie Tools is fully described and priced in the 1936 Composite Catalog.

MacCLATCHIE MUD PUMP VALVES

Before purchasing valves compare prices and convince yourself that you can buy MacClatchie Patented High-Quality "Stream-Line" Valves for even less than most unpatented makes. MacClatchie "Stream-Line" Valves stand in a class by themselves. The correctness of their design, which has not been changed since they were introduced nine years ago is shown by the fact that there are more of them in use than any other make. Four out of five of the largest operators on the Pacific Coast use MacClatchie "Streamline" Valves for 95% of their valve requirements. Made in over 110 styles and types for every make of pump.

MacCLATCHIE SPECIAL TAPER ROD

A universal rod with a rod nut of such taper and so designed as to automatically tighten on the rod threads and insure a firm grip on the piston. It also assures an effective fluid seal and the proper amount of metal contact to withstand hard usage encountered in high-pressure drilling. Made of ball race steel which is tempered to extreme hardness and ground to a perfect finish. The rod can be readily loosened when desired, thereby eliminating all difficulty in removing the piston from the rod. We strongly recommend the MacClatchie taper, but make the same quality rod with any taper desired.

MacCLATCHIE "MONEY SAVER" PUMP LINERS

Quickly and economically replaced when worn. Made of special alloy seamless steel, hardened and ground to a mirror-like finish. On test by oil company engineers they have outrun costly spun metal liners. Their price is about half what other manufacturers charge for ordinary forged steel liners. Our method of manufacturing, using tubing, enables us to give the best liner on the market at an extremely low price.

MacCLATCHIE "WEAREVER" PUMP PISTONS

Designed so that wear is absorbed by the rubbers which are economically replaced for less than half the cost of a new piston. This piston has recently been improved with longitudinal backing on the suction stroke. Leading operators have had it outwear three and four of their choice of the best competitive pistons. These tests were conducted by oil company engineers (names on request).

MacCLATCHIE
MANUFACTURING COMPANY

COMPTON, CALIF. **HOUSTON, TEXAS**

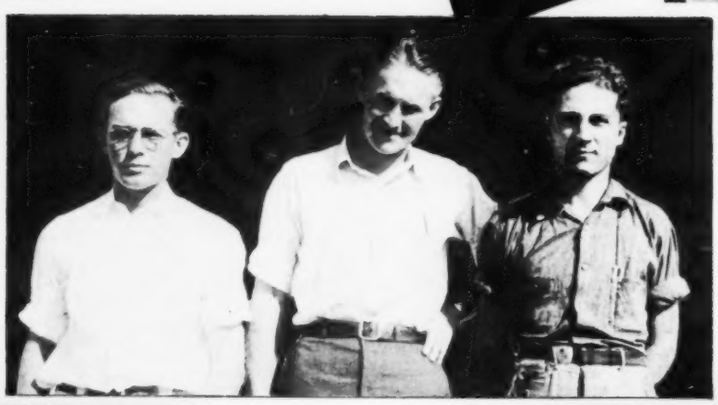
MacClatchie Pump Parts Are Sold by All Leading Supply Houses

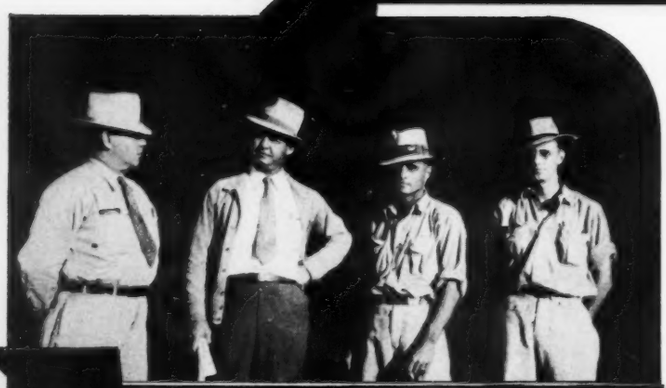
JANUARY 1936

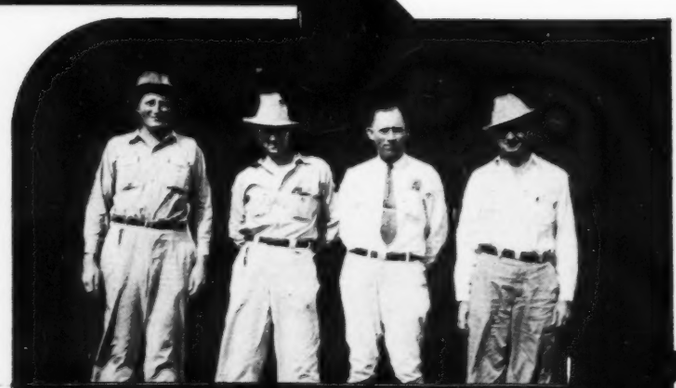
PICTORIAL *Petroleum*

THE HIGHEST PRESSURED OIL WELL IN THE WORLD—
NO. 160 MORENI FIELD, ROUMANIA

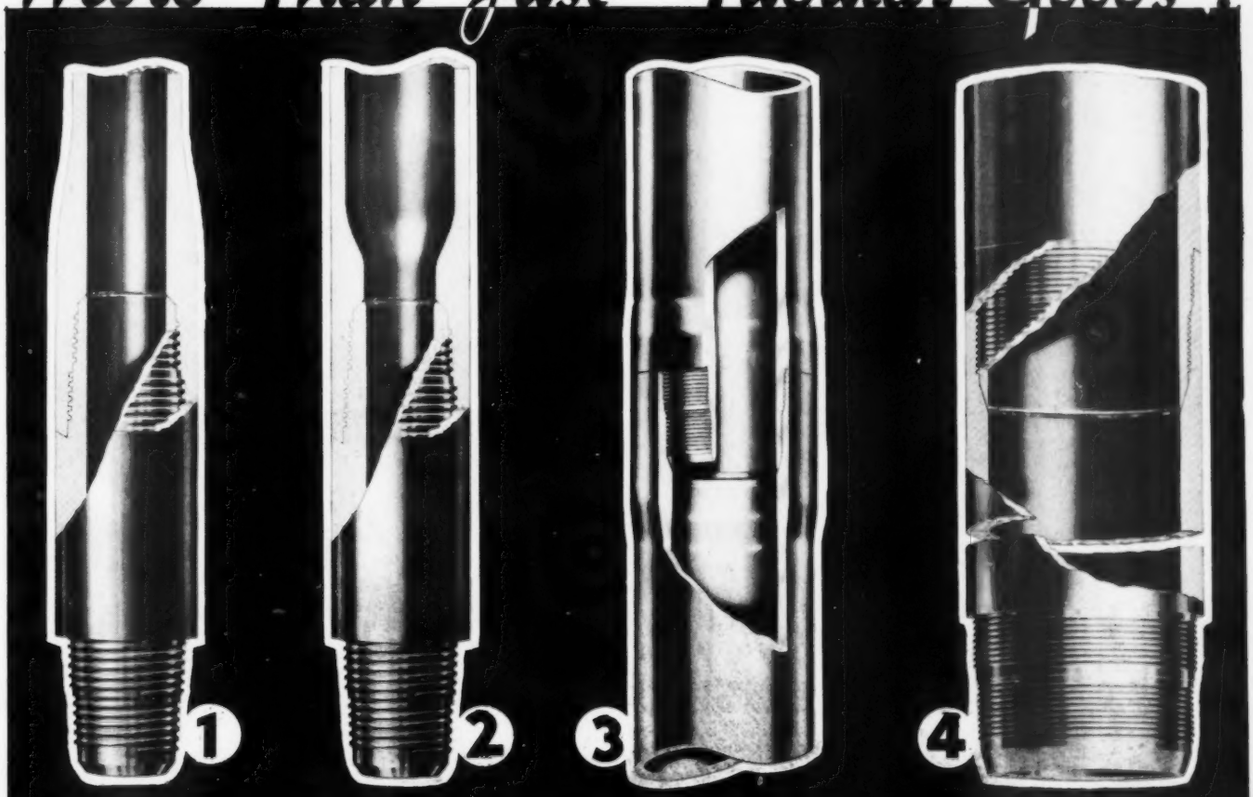
Photograph courtesy of Clarence Lockwood, Houston, Texas







More Than Just "Tubular Goods"!



HYDRIL

DRILL PIPE AND CASING

Are ENGINEERED for every oil field purpose

1

INTERNAL FLUSH JOINT DRILL PIPE

This is the drill pipe joint that utilizes the full hole principle to the utmost. The size of the hole through the tool joint is the same as the full inside diameter of the drill pipe, thus assuring the maximum circulation area obtainable in all sizes of drill pipe. (Patented)

2

EXTERNAL FLUSH JOINT DRILL PIPE

Assures maximum safety and ease of handling when used for drilling against high pressures. Once the packer is adjusted about this drill pipe after the bit or other tools have passed through the packing head, the packer does not have to be loosened while running in, drilling or pulling out of the hole. (Patented)

3

EXTERNAL UPSET CASING

The greater thickness of metal obtained at the joint by means of the external upset makes it possible to construct a casing joint of any desired strength and efficiency. As the diameter of the upset is much smaller than that of a coupling this casing is particularly adapted for long strings which are to be run into holes where clearances are limited. (Patented)

4

INTERNAL AND EXTERNAL FLUSH CASING JOINT

Being externally flush, this casing is run through packers with ease and safety. The special square thread form, exclusive on Hydril Casing Joints, places more metal in shear, defies slippage, screws up easily. The tapered shoulders provide a permanently tight fluid seal. (Patented)

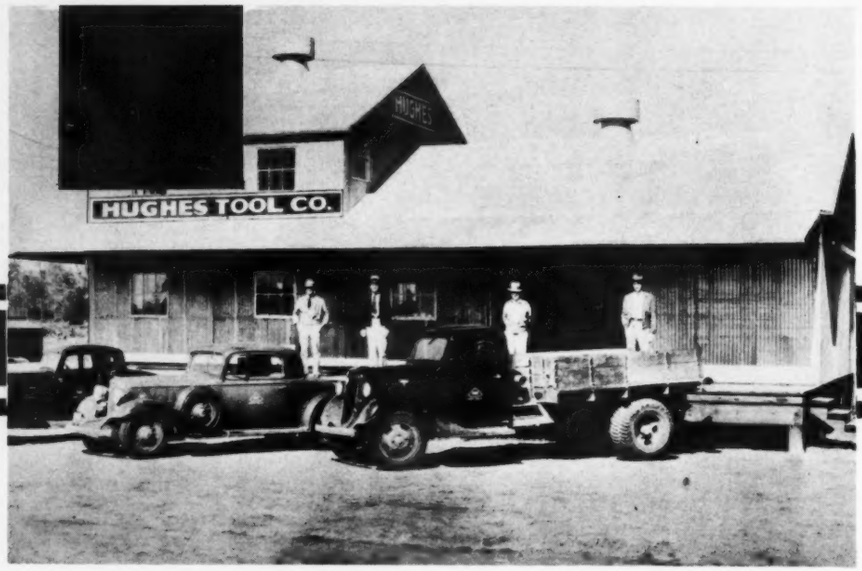
HYDRIL

HYDRIL COMPANY

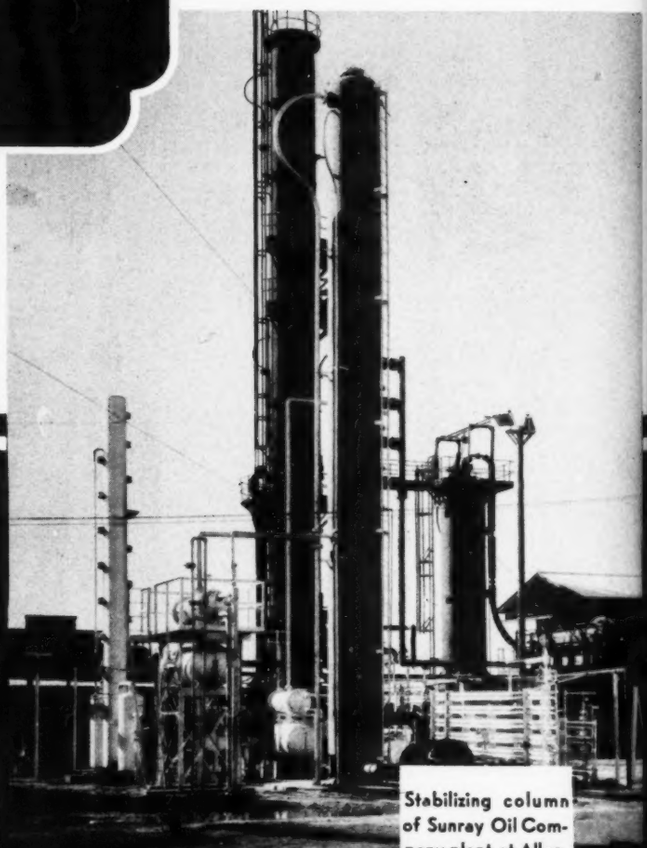
714 West Olympic Boulevard • Los Angeles, California

4300 Calhoun Road, Houston, Texas
(Doheny Stone Drill Co. of Texas)

Cable Address: HYDRIL



Left: H. A. Blackstone, assistant superintendent, Lion Oil Refining Company, El Dorado, Ark. Right: H. M. Van Clief, chief petroleum engineer, Honolulu Oil Company, Taft, California, division

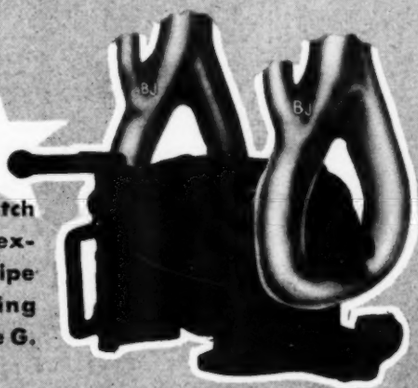


Stabilizing column of Sunray Oil Company plant at Allen, Oklahoma. Built by Petroleum Engineering, Inc.

BJ Extra Heavy Casing and Rotary Tongs are 1935 models, with new features of safety and convenience.

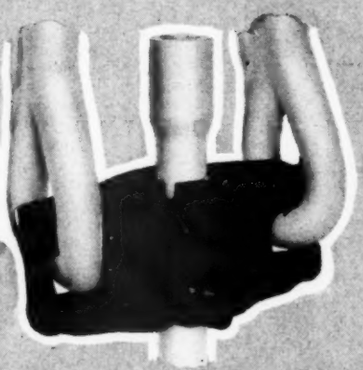
The "hidden" latch, long horns with guards, and simple design of the BJ Type A Drill Pipe Elevator are instantly approved by experienced operators everywhere.

BJ Safety Joints are run in the drilling string—as well as when fishing. They are strong and safe and positive in operation.



This new Center Latch Elevator handles external upset drill pipe without using lifting plugs; specify Type G.

For setting those long, heavy strings of casing, you can depend upon a BJ Side-Door Slip Elevator suspended on BJ Weldless Links from a BJ Triplex Hook.



The Type B Side Door Elevator also safely carries the longest strings of external upset drill pipe.

YOU NEED THESE MODERN TOOLS TO COMPLETE THAT *Deep Drilling* OUTFIT!

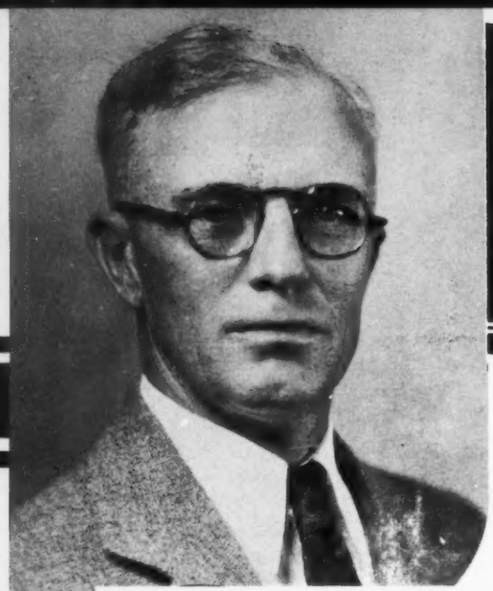
FROM the standpoint of safety and efficiency... particularly in deeper drilling... you can profit by using these new tools.

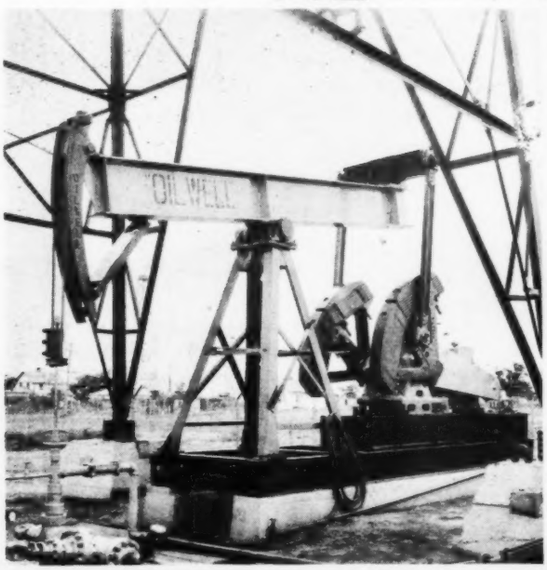
SEE THEM at your supply store... study them in your 1936 Composite Catalog... or write us for the BJ Catalog.

BYRON JACKSON CO.

AND SUBSIDIARY

FORT WORTH • LOS ANGELES • NEW YORK





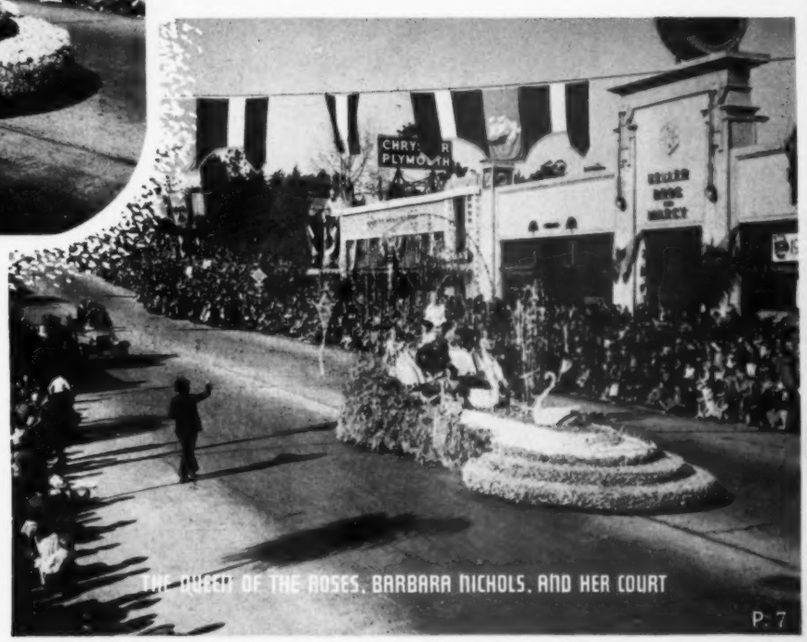
Those who attended the "fishing party" of Martin-Decker Corporation during the A.P.I. meeting in Los Angeles were (names not in order): Weldon Brigance, Rowan Drilling Company, Fort Worth, Texas; Walter H.Meier, Atlantic Production Company, Dallas, Texas; Bruce Robinson, General Petroleum Corporation, Vernon, California; Jack Howard, Globe Oil Tools, Los Nietos; Bill Frazier, Abilene, Texas; A. F. McQuiston, Bakersfield; Walter Stone, Richfield Oil Company, Long Beach; John Augsburger, Long Beach; Herb Stark, Honolulu Oil Company, Taft, California; Ed Larson, Texas Company, Long Beach; Gene Sutton, Globe Oil Tools Company ,Los Angeles; Buck Morris, I.T.I.O., Oklahoma City, Oklahoma; Ernest Parks, Standard Oil Company, Los Angeles; K. N. Saatjian, Texas Company, Los Angeles; H. M. Van Clief, Honolulu Oil Company, Taft, California; C. E. Morris, United Gas Company, Shreveport, Louisiana; George Felker, Crosby Steam Gauge & Valve Company, Boston, Massachusetts; Jack Bagnall, Standard Oil Company, Los Angeles; Sam Furman, Ohio Oil Company, Venice, California; F. E. Lacaze, United Gas Company, Shreveport, Louisiana; Carl Steinbeck, Long Beach; T. E. Ward, Oilfield Equipment Company, New York City; George Barham, Barham Drilling Company, Hobbs, New Mexico; C. W. Chandler, Texas Company, Los Angeles; Frank Lovering, Shell Oil Company, Long Beach; Jack Carpenter, General Petroleum Corporation, Vernon; Harold Winham, Shell Petroleum Company, Wink, Texas; A. R. Stewart, Standard Oil Company, Culver City, California; R. G. Hamaker, Reed Roller Bit Company, Los Angeles; G. A. Manahan, Manahan Drilling Company, Tulsa, Oklahoma; Frank Brinegar, Continental Supply Company, Dallas, Texas; V. W. Smith, Broderick Boilers, Philadelphia, Pennsylvania; L. R. Smith, Associated Oil Company, Los Angeles; George S. MacDonnell, California Oil World, Los Angeles; W. M. Dozier, Advertising, Whittier, California; Bill Linden, General Petroleum Corporation, Vernon, California; H. B. Zacker, Associated Oil Company, Ventura; Roy Blake, Hughes Tool Company, Tyler, Texas; "Frosty" Martin, Martin-Decker Corporation, Long Beach; E. L. Decker, Martin-Decker Corporation, Long Beach; H. J. Blythe, Martin-Decker Corporation, Long Beach; George L. Leslie, Martin-Decker Corporation, Long Beach.

Scenes of the Recent TOURNAMENT OF ROSES

CLOSE UP OF THE QUEEN AND HER COURT

GOVERNOR JAMES ALLRED OF TEXAS WHO WAS THE GRAND MARSHALL

STATE OF TEXAS FLOAT



THE QUEEN OF THE ROSES, BARBARA NICHOLS, AND HER COURT

P. 7

PASADENA

1936

CALIFORNIA

Scenes of the Recent TOURNAMENT OF ROSES

UNION OIL CO. · GRAND PRIZE WINNER · A TRIBUTE TO WILL ROGERS

CLEOPATRA · STANDARD OIL COMPANY OF CALIFORNIA FLOAT

FLOAT OF LAGUNA BEACH POST AMERICAN LEGION

STREET SCENE TAKEN AS PARADE BROKE UP

PASADENA

1936

CALIFORNIA

Any Junk Today!

YOU can remove all junk from the bottom of the hole—safely, quickly and at small expense—with a Globe Basket Bit.

Bolts, nuts, steel splinters, and in fact, any metal pieces up to several inches in size are easily recovered and removed from the well.

HOW IT "FISHES"

This successful tool operates to cut an oversize core with a drill head having narrow teeth which are bevelled and tapered toward the inside. When rotation is commenced these bevelled teeth force all junk to the center of the hole. Continued rotation quickly cuts a large-diameter core which enters the barrel, carrying on its top the junk.

The core passes the two core catchers (which do not rotate after the dogs have engaged the core) and after a few feet of core has been cut the Basket Bit is slowly and carefully picked up. The core catchers then operate to . . .

break off the core and bring it out of the hole with the fish; or the dogs will slide up over the end of the core and the long dogs in the lower catcher close under the "fish" and bring all junk safely out of the hole.

The simple, strong design of the Globe Basket Bit makes it safe and inexpensive to use, and its remarkable success often secures savings in a single run to offset the cost of the tool.

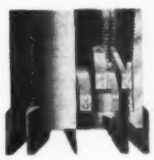
The dogs in the upper catcher do not revolve after engaging the core, and are strong enough to pull cores from hard formations.

The long, closely-set dogs in the lower catcher close under bolts, nuts, or other small "fish" and bring them out of the hole.

OTHER IMPORTANT USES

1. The Globe Basket Bit is also successfully used to bring a crooked hole back to vertical. When rotated rapidly the short, sharp teeth cut away the bend in the hole and start a shoulder. The closely-spaced teeth do not slip off the shoulder, and a new vertical hole is quickly started.
2. For coring hard formations which are not easily washed away, the sharp, narrow teeth of the Globe Basket Bit secure remarkable results.
3. Other uses are as a wash-over shoe when fishing for drill pipe lost in a rat hole, and similar fishing operations.

Note how the teeth are tapered and bevelled toward the center. This view also shows how it is possible to cut oversize cores, for example, a 7¼" core in a 12½" hole.



For recovering larger pieces of junk—which can barely be forced into the barrel—an oversize head with spring type catcher is furnished.

DRILLING, REAMING AND CORING EQUIPMENT

Look for this Trade Mark in the Composite Catalog

GLOBE OIL TOOLS

GLOBE OIL TOOLS COMPANY
(Los Angeles County)
Los Nietos, California, U S A.

Look on pages 502 and 503 of your 1936 COMPOSITE CATALOG for complete descriptions and prices of the Globe Basket Bit; or write us direct for specific information.

Use a GLOBE BASKET BIT!

The First Two-Mile String of 6⅝-in. Casing

By WALLACE A. SAWDON
Petroleum Engineer, Los Angeles

IN a well already noted for the establishment of records, the Union Oil Company has now run and cemented the world's longest string of 6⅝-in. casing. The well is Lillis and Welsh No. 1, Kettleman Hills, California, which was originally drilled to 10,944 ft. by Ed McAdams.[1] An oil sand was picked up near bottom, but the hole was lost before a production test could be made. Operations were later taken over by the Union Oil Company, which is now drilling ahead.

Once holding the world's depth record and the record for the longest string of 7-in. casing, this well again came into the limelight about six months ago with a record string of 8⅝-in., 36-lb. casing cemented at 9081 feet.[2] Within the past month, however, another record was made when a string of Spang Chalfant 6⅝-in. "Extreme Line" 26-lb. Grade D casing was cemented at 10,815 feet. Being floated in, the weight of the string offered no difficulty in safe handling; and being cemented sufficiently far up the hole, the hazard of collapse has been eliminated.

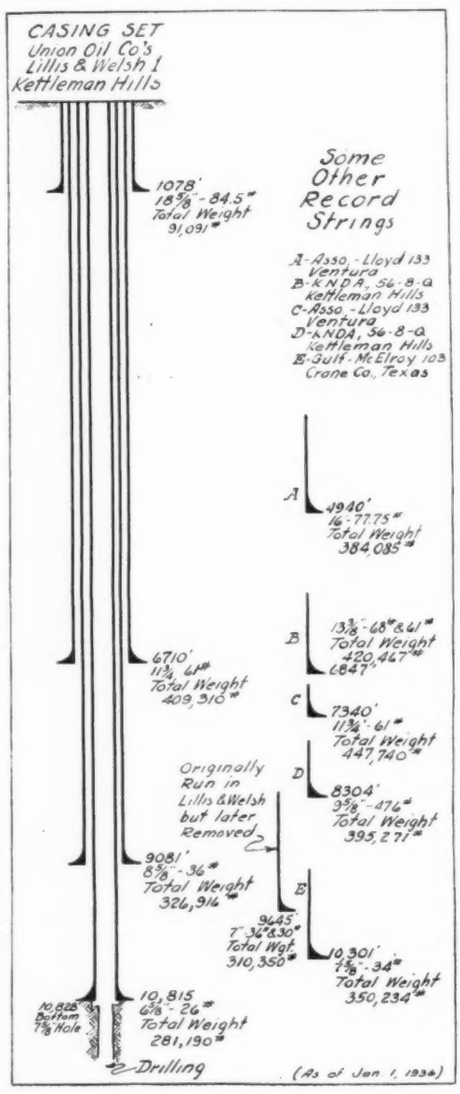
The bottom of the string was equipped with a Baker cement float shoe welded to the lowest joint of pipe. At the tops of the first and second joints were screwed Baker float collars. With a third joint made up on the upper float collar, a circulating head was set in the top and a mud pressure test was made for tightness of this section consisting of the float shoe, two float collars, and three joints—a total length of about 125 feet. After 33 joints were in the hole, the pipe was filled with mud.

At 8000 ft. the 8⅝-in. casing had been collapsed by an earth disturbance for a distance of about six feet. This had previously been rolled out and a length of the 6⅝-in. casing run through the tight spot as a feeler.

In handling the casing, both male and female protectors were left in place until the lengths were swung into the derrick. The female protectors were not removed until each joint was down the hole and standing in the slips.

The Union Oil Company has been conducting considerable research on mud and its proper conditioning during drilling operations. It is felt that the mud control thus developed aided materially in the extremely successful handling of the long strings of casing and in the progress made toward completion of the well. The company has demonstrated its drilling technique in the redrilling operations on this hole. Although attempts were made to complete the well with the 7-in. casing cemented at 9645 ft., this long string had to be removed and work resumed from the depth of 6710 ft. where the 11¾-in. string had been cemented. The ease of running and cementing both the 8⅝-in. and 6⅝-in. strings speaks well for the condition of the well at the present time.

Drilling below the 6⅝-in. casing is now being carried on and there is a possibility that the well will exceed a depth of 11,000 ft. before it is finished.



REFERENCES

[1]"Kettleman Hills Well Now Holds Depth Record", by Wallace A. Sawdon—*The Petroleum Engineer*, May, 1933.

[2]"Union Oil Sets Heaviest String of Casing", *The Petroleum Engineer*, p. 56, September, 1935.

Statistical Review of the Petroleum Industry in the United States for the Year 1935

By
WM. J. KEMNITZER

THE statistical position of the petroleum industry during the year 1935 was the best since 1920. Total demand for all petroleums was the largest since 1929; exports were the largest since 1930; and domestic consumption was the largest in the history of the industry. Stocks at the end of the year were the lowest since 1926; and the days' supply in them the least since 1920.

Prices were the highest since 1930 but only slightly improved over those of the year 1934. Despite this improvement, prices did not attain the levels warranted by conditions of supply-and-demand and the purchasing power of the dollar. The all-commodities price index for the year averaged 80.0 while the all-petroleum price index averaged only 51.0, or 36 percent below the average for all-commodities. For the assumed normal year 1926, when the all-petroleum price index averaged 100.0, the days' supply in stocks was 210. For 1935 when the petroleum price index was 51.0, the days' supply in stocks was 181.

Obviously, petroleum prices were at subnormal levels during the year 1935. This paradox of low prices at a time of exceptionally good statistical position reflected the inevitable economic contradiction of the "proration" system which continued during the year. Lower-cost oil from flush fields continued to dominate the markets. While the output from new wells was curtailed, nevertheless, action to limit the supply placed a premium on drilling in order to procure it, and thus the "potential" continued to increase. High or "normal" prices were impossible of attainment so long as the "potential" remained to be developed.

To counteract the ordinarily adverse effect of the contradictions of the "proration" system on price, domestic production during the year was restricted below the total demand. In so doing a large margin of the markets was reserved exclusively for imports and withdrawals from stocks. Since these two items of supply are almost exclusively in the hands of the larger integrated companies, these organizations were able to increase their sales during the year and so increase profits. It follows, of course, that such profits were made at the expense of those domestic producers and partially integrated organizations dependent solely on a domestic supply. Continuance of the policy of restricting domestic production below total demand—despite subnormal prices—means improved profits for the so-called "major" companies during 1936 with corresponding handicap for the smaller so-called "independent" operators.

Total demand for all oils in terms of crude petroleum during the year averaged 3,003,000 barrels daily, the largest since 1929 and 5.9 percent above the 2,835,000 barrels daily last year. Exports averaged 342,000 barrels daily, the largest since 1930, and 8.9 percent above the 314,000 barrels for 1934. Domestic production averaged only 2,801,000 barrels daily, likewise the largest since 1929, and 8.0 percent above the 2,593,000 barrels during 1934. Imports averaged 145,000 barrels daily, the highest since 1932 when a tariff was placed on petroleum products, and 5.1 percent above the 138,000 barrels of last year. Withdrawals from stocks averaged 57,000 barrels daily compared with an average of 104,000 barrels daily last year.

Following is a tabular summary of essential statistics of the petroleum industry for the year 1935, compared with those of 1934:

(000's omitted)

Item	1934	1935
Domestic Production	2,593	2,801
Imports	138	145
Change in stocks	−104	−57
Total demand	2,835	3,003
Exports	314	342
Domestic consumption	2,521	2,661
Stocks:		
Total	563,163	543,599
Days' supply	199	181
Price index:		
All-petroleums	50.5	51.0
All-commodities	74.9	80.0

Inadequate Plugging Methods or Faulty Casing May Cause Water Contamination

Studies made by the United States Bureau of Mines, Department of the Interior, in co-operation with the Kansas State Board of Health, have emphasized that the casing in producing oil wells must be kept in proper condition and abandoned wells must be plugged by methods suitable to the conditions in the individual wells and in the formations they have penetrated if fresh-water supplies and oil and gas resources are to be protected. Salient points pertaining to mineral contamination of fresh-water supplies through inadequate plugging methods or faulty casing have been presented in a brief and elementary discussion prepared by Ludwig Schmidt and C. J. Wilhelm, petroleum engineers of the Bureau of Mines. The authors of this informative pamphlet conclude that the abandoning and plugging of each well is a separate problem, but show that methods are available, which, if used in accordance with good engineering practice, should reduce to a marked degree the mineral contamination of fresh-water supplies by subsurface brines.

Following prefatory statements regarding the composition of oilfield brines and their effect on animal and vegetable life, the sources from which waters high in mineral content enter fresh-water supplies are described. These are dealt with in two general classes, namely subsurface and surface sources. Methods of plugging are discussed, and simple illustrations show types of improper plugs that allow depletion or mineral contamination of fresh-water sands. The booklet discusses the judicious use of mud fluids and cement and their limitations and shows how faulty casing, either improperly seated or corroded, may permit brines to migrate to fresh-water or oil-producing horizons.

Copies of this booklet of 15 pages and five illustrations are being distributed by the Kansas State Board of Health, Lawrence, Kansas, in accordance with a co-operative agreement with the Bureau of Mines pertaining to the disposal of oilfield brines.

Engineering Fundamentals Department

- A Study Course for Field and Plant Men
- A Review for Experienced Engineers

W. L. NELSON
K. C. SCLATER
Editors

Elements of Applied Petroleum Production

By K. C. SCLATER

Article 27

INCREASING ULTIMATE YIELD OF OIL

ONLY a fraction of the quantity of oil originally in the sand when a pool is discovered is produced by employing ordinary methods of production. It is estimated that this fraction is from 15 to 25 percent of the original oil content, the remaining 85 to 75 percent is left in the sand. This is the reason that so much attention now is paid to the entire method of developing and producing an oil pool, for by proper development and production practice, the ultimate yield of oil can be increased.

CONSERVING GAS IN SAND

Conservation of gas in the sand is one of the most effective means of increasing the ultimate yield. Gas in the sand associated with the oil is under pressure and therefore has potential energy. This energy is given out as the gas expands and should be utilized to bring the oil into the well. Oil in flowing through the sand uses up energy and this the gas under pressure supplies. A reduction in pressure occurs as oil is produced and is greatest in the vicinity of the well bore. This sets up a differential pressure between the well and distant parts of the sand, sufficient to cause a movement of the oil and gas toward the hole. Another source of energy driving the oil and gas toward the hole is hydrostatic pressure. In producing oil, therefore, the ultimate yield can be substantially increased by conserving this energy. This is done by maintaining pressure control of flowing wells and holding the gas-oil ratio to the minimum. Pressure control and the maintenance of a low gas-oil ratio is also carried out in pumping wells although the net effect of increasing the ultimate yield is less pronounced in wells of this class.

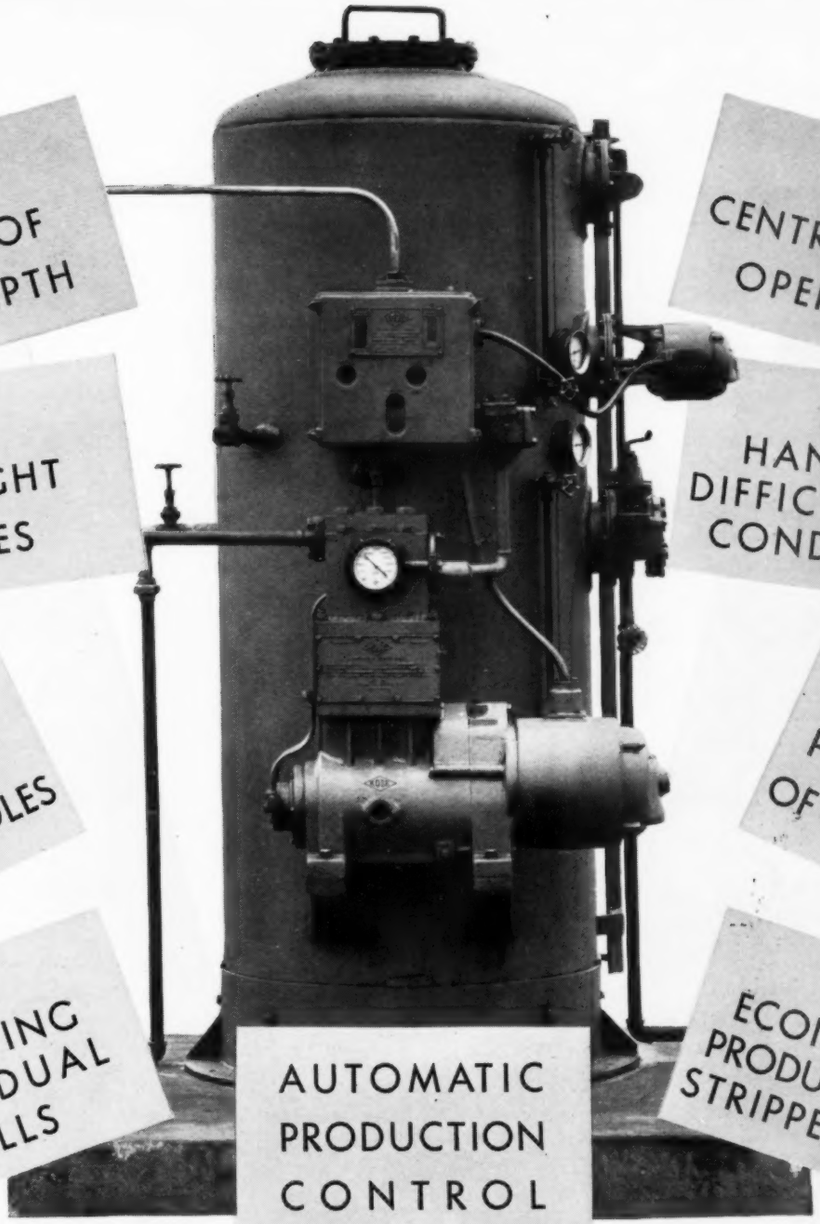
Pressure control of flowing wells is almost universal practice today. As soon as a well is completed it is tubed with the proper size tubing for the required rate of flow so that a low gas-oil ratio will be obtained. Adjustable flow beans, or choke nipples, are used to maintain the proper rate of flow and take care of gradually changing conditions in the well. Flow beans are usually placed at the tubinghead or at the beginning of the flow-line between the well and separator. Bottom-hole flow beans are used occasionally when it is desired to obtain a finer adjustment and where the possibility of materially reducing the gas-oil ratio is favorable. The function of the flow bean on the well is to change the pressure at the face of the sand, and thus to obtain a rate of flow that will give a low gas-oil ratio for the flowing conditions obtaining in the well. These flowing conditions are influenced by the size and length of flow string in the well. If the gas-oil ratio is too high it may not be possible to reduce it with flow bean adjustment alone, but instead may necessitate making a change in the flow string.

On pumping wells that have a high gas-oil ratio it is possible by means of pressure control to lower the ratio. One means of doing this is to close the well in at the casinghead and hold a pressure in the annular space between the casing and tubing. The amount of pressure to hold usually is determined by field tests. Holding a pressure in the annular space increases the pressure on the face of the producing sand and has the same effect as reducing the size of the flow bean, or choke nipple, on a flowing well. Sometimes a tubing packer, set in the casing at a suitable point above the pump, is used to obtain the required pressure on the face of the sand while pumping.

GAS INJECTION AND REPRESSURING

Secondary recovery methods are resorted to for increasing the ultimate yield of oil. They differ from the methods just discussed in that they utilize a secondary source of energy. Two such secondary recovery methods are gas injection and repressuring. In each of these methods compressed gas or air or both may be employed as the source of energy.

The gas injection method is used to maintain reservoir pressure only or to hold the rate of decline in check. Repressuring, on the other hand, as the name implies, is employed to build up pressure in the reservoir to replace the depleted energy. The injection method, as might be supposed, is employed in fields that have just passed the flush stage of production.[105] High-pressure gas is injected into the reservoir in sufficient volume to maintain the decline of reservoir pressure at some predetermined rate found most economical for efficient well operation and production. This secondary method of recovery is not so widely practiced as the repressuring method wherein the reservoir pressure is built up. One



FOR WELLS OF ANY DEPTH

FOR CENTRAL PLANT OPERATION

FOR STRAIGHT HOLES

FOR HANDLING DIFFICULT WAX CONDITIONS

FOR EXTREMELY CROOKED HOLES

FOR PUMPING OIL OF ANY GRAVITY

FOR OPERATING INDIVIDUAL WELLS

AUTOMATIC PRODUCTION CONTROL

FOR ECONOMICAL PRODUCTION OF STRIPPER WELLS

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reason for this is that with proration and curtailment in effect in all flush fields the rate of production is low, so the necessity for maintaining reservoir pressure is not felt.

Repressuring is applied to fields that are depleted of gas energy but whose sands still retain substantial quantities of oil.[106] Many repressuring projects are found in oil fields that have been producing for 20 years or more.[107] Operators in a pool to be repressured usually enter into a coöperative working agreement whereby all can share in the benefits of the repressuring operation. It manifestly is not possible to get the utmost benefit unless all owners of adjacent leases are in on the project. For this reason, careful preliminary surveys are made of the possibilities of a repressuring project for a pool.

Such preliminary survey involves a thorough study of subsurface conditions; the physical characteristics of the sand, the amount of oil in the sand and the probable amount that can be recovered, and the presence of water, all are investigated. Each well is examined and its record studied. Casing seats and the condition of the casing are investigated. A leaky well, unless put in good condition, can be a source of serious gas loss when gas injection is begun.

Key wells must be selected.[108] These are for the injection of gas and are placed at those most advantageous points in the reservoir where the records show the sand to be favorable for the injection of gas. It may be found necessary to drill new wells for this purpose. It is important that key wells be in good condition. The casing and casing seat must be tight and not likely to spring a leak. The number of key wells necessary will depend on the quantity of gas and its injection pressure.

Injection of gas must be considered from the point of cleanliness and the absence of any impurities that are likely to form a precipitate in the sand and thus clog the pores. Sometimes the presence of water that may contain certain salts will cause a deposit when the gas comes in contact with it. Water and gas analyses therefore are important.

Injection pressures required will be determined from field tests. The ability of the sand to take the gas being known beforehand, and the quantities of gas to be injected, the injection pressures necessary for different rates of injection are tabulated. One factor given consideration is the rate at which the pressure can be built up at different rates of injection, for the available volume of gas for repressuring may not be constant. All key wells will not have the same injection pressure. This will depend on the sand conditions at the well.

Control of the pressure build-up after injection begins is aided by controls at the key wells, and also by control of the rate of production at the producing wells. Gas-oil ratios are closely watched on producing wells and the input volume of gas is measured at the key wells. These figures are checked against the rate of pressure build-up at the producing wells and adjustments made as found necessary. Too high a gas-oil ratio may indicate by-passing of the gas in the reservoir. This means that part of the gas energy is being dissipated. Higher back pressure on the producing well or a lower injection pressure on the key well may be necessary. Sometimes it is possible to flow the production through a flow string of small diameter after the reservoir has been built up to a certain pressure.

When a repressuring project that has been properly engineered is well under way, the matter of production becomes a routine operation not unlike that in an oil field that has not quite reached the settled stage of production. Gas-oil ratios are held to the minimum and all possible sources of leaks, such as casingheads and defective subsurface casings, are carefully checked. Suburface pressures, gas-oil ratios, injection pressures, and input volumes of gas are recorded at regular intervals. These form a working sheet for the man in charge.

Gas injection and repressuring are valuable methods to employ for increasing the ultimate recovery of oil. There are few sand fields in the settled stages of production where repressuring cannot be employed to advantage.

WATER - FLOODING

Another secondary recovery method is water-flooding. Water under pressure, instead of gas, is the secondary source of energy utilized to propel the oil through the sand to the well.[109] It is interesting to note that the water-flooding process was originally the result of accidents to casing and tubing, but it has gradually passed from an accidental condition to a definite engineering procedure.[110] Water-flooding is not in such widespread use as repressuring. Perhaps the reason for this is that the conditions under which water-flooding can be applied are more limited. One thing, you cannot experiment with water-flooding so freely as you can with gas repressuring. Water-flooding an oil sand may ruin it for the production of oil if the flood is not successful or is not properly controlled. Water-flooding has reached its highest stage of development in the Bradford field, Pennsylvania.[111] The sand in that field is relatively uniform in texture and is free from natural water encroachment. Water-flooding projects recently have been begun in other fields, particularly Oklahoma. It may have wider application in the next few years for increasing the ultimate recovery from old depleted fields. Where it is applicable, water-flooding probably will give a greater increase in ultimate recovery, and more quickly than repressuring methods.

There are several types of water-flooding systems, and these are classified according to the layout of the water injection wells with respect to the producing wells. These systems are: circular flood, line flood, five-spot flood, and five-spot delayed flood.[112]

Reservoir conditions have to be carefully investigated when a water-flooding project is being considered, particularly with regard to the permeability of the sand, the porosity, the saturation, and the variation of sand texture. Water has a high resistance to flow through the sand hence the permeability of the sand, which is in effect the resistance it offers to the flow of fluids through it, has to be given careful consideration. The porosity and the saturation are a measure of the oil content and the amount of oil that can be recovered. Technique in the investigation of sand conditions has reached a refined stage in the fields of Pennsylvania, where water-flooding is practiced. Cores, taken by cable tool core bits, are taken systematically and carefully tested. The procedure followed in testing these core samples and analysing the results is very exacting.

QUESTIONS

1. What is meant by a secondary recovery method?
2. In what way does it differ from natural production methods?
3. Explain briefly gas repressuring.
4. How does it differ from gas injection?
5. In what respects is the application of the water-flooding method limited?

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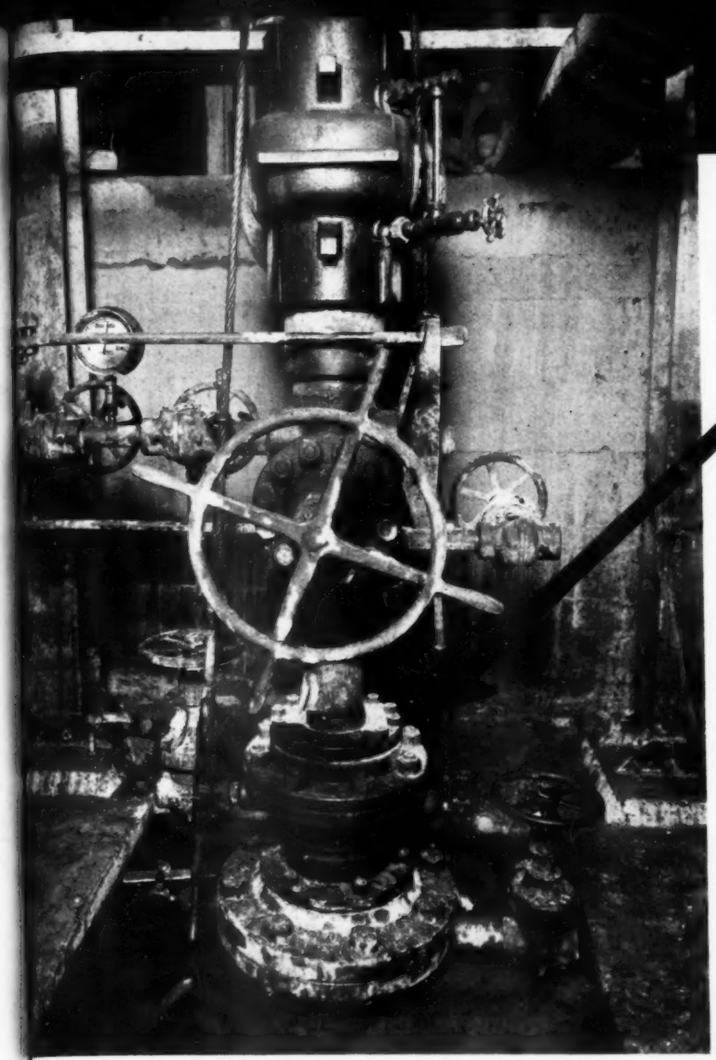

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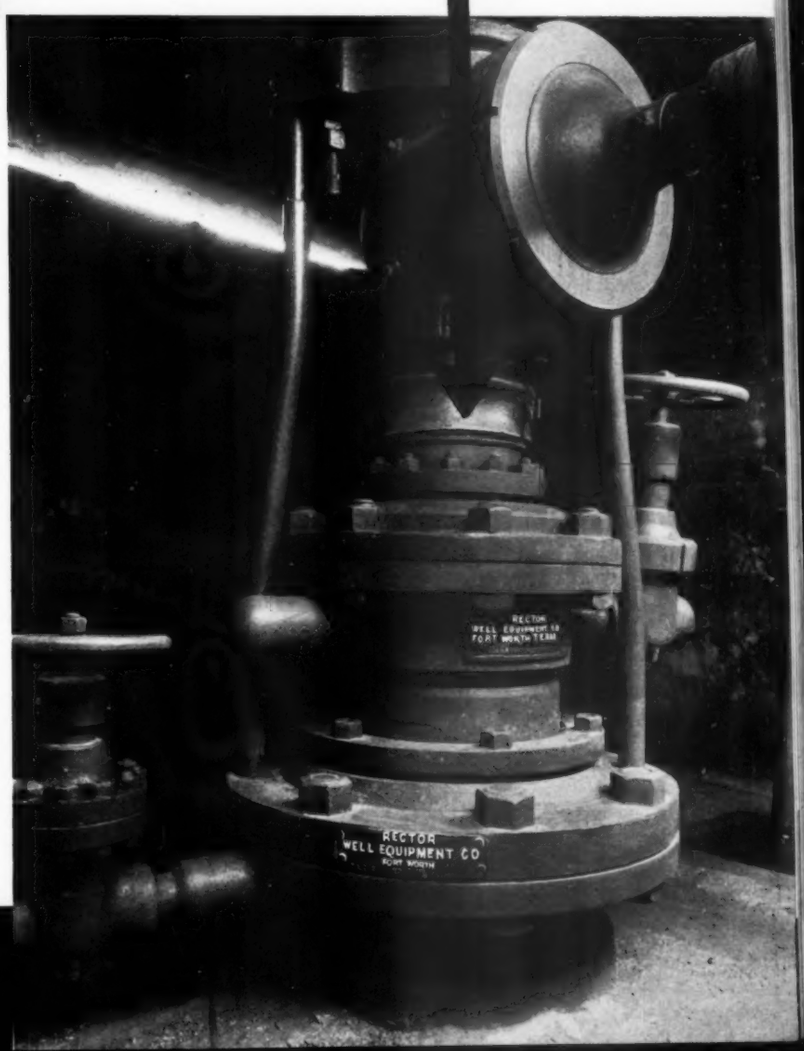
RIGHT: *Showing 3-string* RECTORHEAD *hook-up at Bosco, La. Total weight of pipe in the hole is 408,397 lbs.*



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Article XXVII

REFINERY CORROSION

THE yearly loss in refineries due to corrosion is tremendous and involves factors that are continually receiving attention. One of the major difficulties in studying corrosion is the fact that the results of an experiment are often long deferred, and too late the refiner discovers that unsuitable construction materials had been used or that a severe corrosion exists where it was not expected.

The kinds of corrosion that may occur in a refinery may be classified as follows:

1. Sulphide Corrosion.
   (a) Low temperature.
   (b) At a temperature exceeding 400 deg. fahrenheit.
2. Hydrochloric Acid Corrosion.
3. Atmospheric Oxidation.
   (a) Rusting at room temperatures.
   (b) High temperature oxidation in furnaces, etc.
4. Corrosion by Chemicals.
5. Soil Corrosion.

Of these types of corrosive action, the first two, sulphide and acid corrosion, are of major importance. Although the others are also important, they are not directly refinery problems and in the case of low-temperature oxidation little can be suggested except to keep the equipment well painted. High temperature oxidation is a study in itself and it will be mentioned in Article XXVIII of this series next month.

SULPHIDE CORROSION

There are two main sources of sulphide corrosion. One is the hydrogen sulphide gas found in many natural gases or dissolved in crude oil, and the other is caused by sulphur compounds that are found in crude oil. Some of these compounds such as the mercaptans or thio-alcohols, are directly active but others are not harmful until they have been decomposed during distillation and cracking. In fact, a tremendous number of sulphur compounds are present in crude oil and the precise behavior of each of them is not known.

Hydrogen sulphide attacks steel parts rapidly and hence most of the process equipment in a refinery is subject to sulphide corrosion. The presence of moisture facilitates the action and a small amount of oxygen in the sulphide gas greatly increases the action of the sulphide.[1]

In distillation equipment, sulphide corrosion becomes noticeable at 400 deg. fahr., and rapid at 700 deg. fahrenheit. Thus, sulphide corrosion is found to be most active in the hotter parts of distillation equipment such as the furnace tubes, shellstills, vaporizers, fractionating towers, and hot vapor lines; however, some high-sulphur oils cause corrosion in all parts of the distillation equipment.

Several investigators[2, 3] have studied the effect of sulphide corrosion on various metals and alloys in commercial equipment. In general, the chromium steels are all resistant to sulphide corrosion but their physical properties are greatly improved by the addition of small amounts of such other elements as nickel and molybdenum. Fig. 55 shows a comparison by Speller[4] of the resistance of chromium steels to the resistance of 0.1 carbon steel. The steels were exposed to several corrosive conditions in about ten refineries.

The corrosive action of sulphur-bearing oils is not directly proportional to the sulphur content. Some organic sulphur compounds are relatively stable even at elevated temperatures, whereas others are very active. Thus, some high-sulphur crude oils and distillates give little trouble and others that contain much less sulphur are very corrosive. Perhaps the most satisfactory method of determining the corrosiveness of a sulphur-bearing oil, is to try the oil in various conditions that simulate those encountered in the refinery.

ACID CORROSION

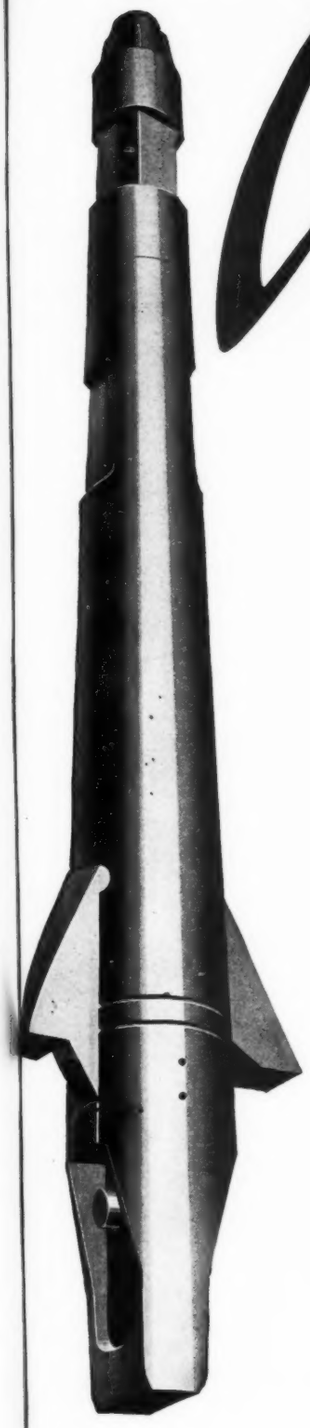
Hydrochloric acid is not present in crude oil but it is often produced during distillation by the hydrolysis of such chloride salts as magnesium chloride. These salts are found in the brine that is associated with most crude oils. Sulphuric acid may also be produced in small quantities by the oxidation of hydrogen sulphide. These acids cause corrosion in vapor lines, condensers, coolers, and run-down lines. Corrosion appears to occur most actively at points in which water may collect such as at valves, low places in lines, and in separator tanks.

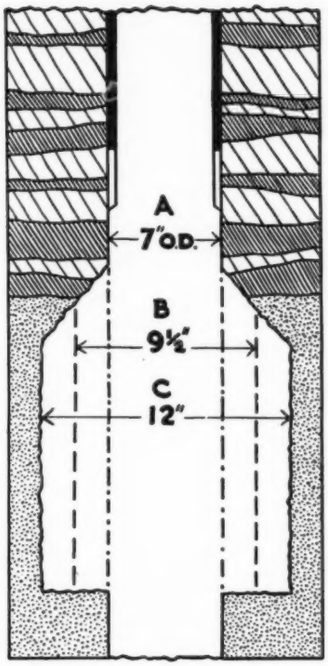
No common materials except glass or ceramic ware are suitable for withstanding dilute hydrochloric acid corrosion. The best materials are alloys that consist mainly of copper but none of these is really satisfactory. The most widely used copper-base alloy is admiralty metal, which consists of about 69 percent of copper, 30 percent of zinc, and one percent of tin. This alloy is used for condenser tubes in almost all refineries; however, admiralty metal and the copper-base alloys are poor resistors to sulphide corrosion and hence, plain steel tubes are used in condensers that suffer by sulphide corrosion. If hard water is used in admiralty metal condensers, the scale should be cleaned from the tubes frequently because corrosion appears to take place most actively beneath porous or chipped parts of the water scale.

The process of metallizing has been used with some suc-

*Professor of Petroleum Refining, University of Tulsa.

BRIDGEPORT Announces THE "ROE" UNDERDIGGER





Above: Illustrating enlargement of the "pay" formation with the Roe "Pay" Underdigger. Here the "pay" in the 6⅛ inch hole was first enlarged to 9½ inches, then later enlarged to 12 inches.

Underdigging of the hole may be started at any point below the casing and enlargements of as little as one inch, or as much as double the original size of the hole, may be made as desired.

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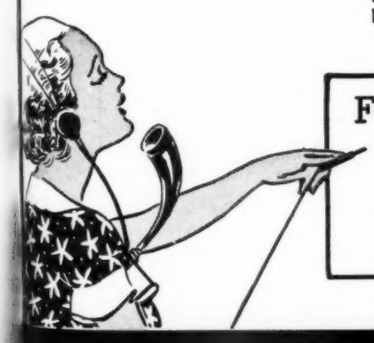

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cess in combating corrosion by hard or salt water in condensers or coolers. In this process a thin coating of corrosion-resistant metal is applied to the surfaces. The surface is first cleaned by means of a sand-blast and the metal is then sprayed on the surface by means of a special torch referred to as a metal gun.[5] Copper and copper-base alloys have been applied by metallizing to header boxes, lines, valves, tubes, etc., that are exposed to corrosive water.

NEUTRALIZING CHEMICALS

Obviously all refinery equipment cannot be built of chromium steel or admiralty metal and hence it is usually necessary to use ordinary steel even though it does not resist corrosion; however, chemicals that are neutralizers for sulphide corrosion and acid corrosion are sometimes useful. Lime is most widely used to alleviate sulphide corrosion. It is added

TABLE 40

CORROSION IN REFINERIES

Equipment	Severe Conditions		Resistant Materials or Remedy	Material normally used or in absence of severe conditions
	Corrosion	Others		
Tubes, Topping	H_2S, Oxidation, and H_2SO_3*	400-900 deg. fahr	0.5 Mo Steel (mild conditions) 5 Cr Steel (sometimes 1W) 18 Cr 8 Ni Steel	0.2 C Steel
Cracking	H_2S, Oxidation	800-1200 deg. fahr High Pressure	5 Cr Steel (or W or Mo) 18 Cr 8 Ni Steel	0.2 C Steel
Tube Supports	High-Temperature Oxidation	1000-1500 deg. fahr to 2100 deg. fahr	12-16 Cr Steel 35 Ni 5 Cr 10 Al Rest Fe 28 Cr 8 Ni Steel	
Return Bends and Headers	H_2S and Oxidation		0.75 Cr 2 Ni Cast Steel 5 Cr Steel	Cast Steel
Plugs	H_2S and Oxidation		Forged Steel (tend to freeze) 22 Cr 1.8 Ni 1 Cu Steel Monel or Muntz metal	Aluminum Bronze Muntz metal
Stud Bolts	Oxidation	Severe Stress	1.5 Ni 0.7 Cr 0.8 Mn 0.4 C Steel 1 Cr (or Mo) 0.4 C Steel 8 Cr 20 Ni 1.25 Si 0.45 C Steel (for corrosion)	Steel
Gaskets	H_2S and Oxidation		Pure Iron, Pure Aluminum or Stainless Iron	Copper
Shells or Chambers		High Pressure	Thick Steel 1-1.5 Mn 0.25 C Steel 1-3.8 Ni 0.3 C Steel 1 Cr 0.17 Va 0.3 C Steel 18 Cr Steel 18 Cr 8 Ni Steel (or linings of these materials)	0.2-0.3 C Steel
	H_2S and HCl			
Valve Bodies	H_2S or HCl		2 Ni 0.75 Cr Cast Steel 5 Cr 1W 0.5 Mn Steel	Forged or cast steel, cast iron or brass
Trim	Oxidation, H_2S or Brine		12-14 Cr Steel 20 Cr 8 Ni Steel 5 Cr 0.5 Mo Steel Nickel and Monel Metal	Brass or bronze
Fans for Flue Gas	High-Temperature Oxidation		12-14 Cr Steel 18 Cr 8 Ni Steel 70-30 Monel (fair)	Steel
Fractionating Towers	HCl or H_2S, and H_2SO_3*		Neutralizing chemicals Thick Steel or Cast Iron	Steel or cast iron
Bubble Caps	HCl or H_2S, and H_2SO_3		Cast iron or rolled low alloy steel	Cast iron
Vapor Lines	H_2S or HCl		Thick steel 18 Cr 8 Ni Steel Neutralizing Chemicals	Steel
Condensers, Tubular	HCl, hard water		Admiralty metal tubes Muntz metal tube sheets Cast iron shells	Steel tubes Cast iron shells
	H_2S		5 Cr Steel tubes 18 Cr 8 Ni Steel tubes 1.5 Ni Cast iron shells 18 Cr 8 Ni 2.5 Si shells	
Coil-in-box	H_2S or HCl, and hard water		Extra heavy pipe Cast iron class D Wrought iron Monel or Muntz metal bolts	Extra heavy pipe Cast iron pipe
Treating, Agitators	H_2SO_4 Concentrated H_2SO_4 dilute Sludge Acid Caustic Soda		Steel or cast iron Sheet lead	Steel Lead
Lines and fittings	H_2SO_4 and NaOH		Lead lined pipe Duriron	
Sweating pans	H_2O and trace of acid		Lining of Monel or Aluminum	Steel
Storage Tanks, Inside	H_2S and brine		Aluminum roof China wood oil paints, and varnishes Redwood	Steel
Outside	Oxidation and soil corrosion		Paints Dry porous foundations Copper bearing steel	Steel
Pump Plungers or Rods	H_2S and HCl		12 to 14 Cr Steel 1.5 Cr, 1.25 Al Steel (if no acid)	Machine steel
Liners	H_2S and HCl		Nothing truly satisfactory	Cast iron

*Pressure distillate rerun units.

in the form a slurry, in the charge to the pipestill or into evaporators or towers. Sodium hydroxide also has been used but it tends to cause caustic embrittlement of steel parts and it accumulates on bubble trays, etc. The lime finds its way into the fuel oil or residual product and if it is present in large quantities it may be troublesome when the fuel oil is fired in boilers, stills, etc. During firing, the particles of lime are carried in the flue gas and are deposited on the tubes, causing a poor transfer of heat, or they may combine with the refractory walls of the still, forming a slag-like fusible material. If an abnormally large amount of lime is present, the walls may be destroyed in a few months of operation.

Ammonia, either as a gas or in aqueous solution, is the most widely used neutralizer for acid corrosion. The ammonia is usually introduced into the top of the fractionating tower or into the condenser system because acid corrosion occurs most actively in these parts of the equipment. Solid ammonium chloride tends to accumulate in the lines and at fittings, and it must be washed from the equipment with water during cleaning periods.

Ammonia should not be used in admiralty or brass tube condensers except in small amounts, because it attacks these alloys even more violently than acid corrosion.[6] If ammonia is used, steel tubes are most satisfactory. If sulphide corrosion and acid corrosion occur simultaneously, neutralizers must be used because no common construction materials will withstand both kinds of corrosion—acid corrosion attacks chromium steel and sulphide corrosion attacks admiralty metal. In fact, a combined corrosive action is very difficult to meet and no truly satisfactory solution is available.

CORROSION BY CHEMICALS

In the handling of the sulphuric acid, lead and steel or cast iron are the standard materials. Lead withstands dilute acid and steel can be used for concentrated acid; however, care must be taken to see that moisture, even the moisture in the air, does not get into steel lines that are used for concentrated acid. One refiner reports that almost no corrosion occurs in concentrated-acid lines if air is not allowed to enter the lines when they are not in use. The same materials are suitable for handling acid sludge.

Lead is an awkward material to handle because of its ductility and lack of strength. For this reason, the process of metallizing as mentioned previously is proving useful. The inside of agitators, etc., is sprayed with lead rather than to support sheet lead by numerous bars and straps.

The chrome, nickel, and silicon alloy cast irons are also used to resist the action of chemicals but they are not widely used in the refinery. Ordinary cast iron is widely used because of its cheapness.

SUMMARY OF CORROSION

The many parts of a refinery that suffer by corrosion may be best introduced by means of a tabulation. Table 40 is a list of refinery equipment, the corrosive conditions that may exist in each, and the materials that may be used to resist the corrosion. The materials shown in Table 40 are not used as extensively as might be inferred. Each corrosive condition is a new problem and the method of combating the corrosion will depend entirely on the severity of the action and upon local conditions. Frequently the material that is most widely used is not resistant to the corrosive action but it is more economical to replace the equipment from time to time than to buy more expensive materials. As an example, fractionating towers suffer by acid corrosion and sulphide corrosion but they are always constructed of steel. The shells of the towers are usually more than one-half inch thick, although a thickness of one-quarter inch is usually sufficient for structural purposes.

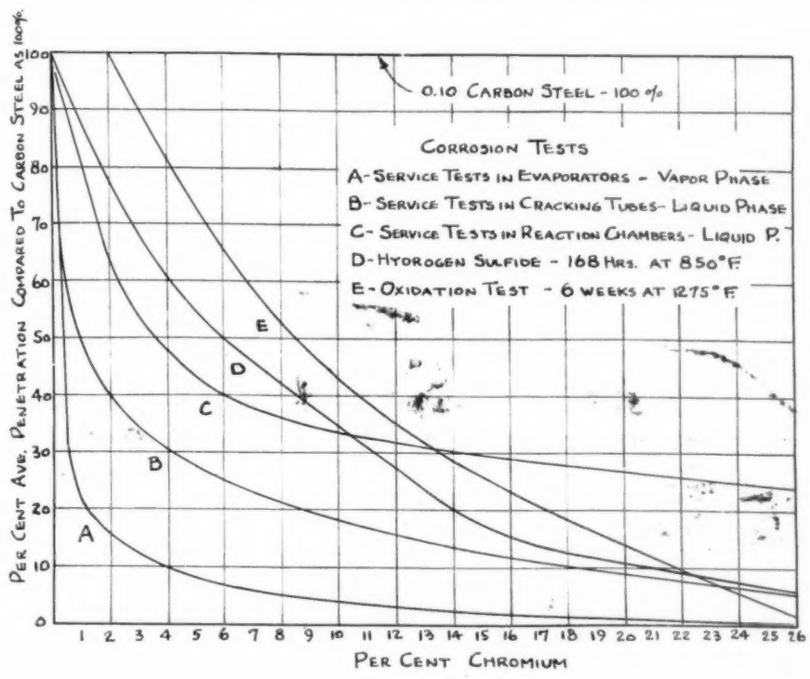
Per Cent Ave. Penetration Compared To Carbon Steel As 100%
0.10 Carbon Steel - 100 %
Corrosion Tests
A- Service Tests in Evaporators - Vapor Phase
B- Service Tests in Cracking Tubes- Liquid Phase
C- Service Tests in Reaction Chambers - Liquid P.
D- Hydrogen Sulfide - 168 Hrs. at 850°F.
E- Oxidation Test - 6 weeks at 1275°F.
A
B
C
D
E
Per Cent Chromium

Fig. 55. Relative corrosion resistance of chromium steels

QUESTIONS

1. What are the two main kinds of corrosion in refineries?
2. What materials are best for resisting these two kinds of corrosions?
3. What two neutralizing chemicals are most widely used?
4. Why are iron and steel used so extensively in the refinery although they are not resistant to most corrosive agents?

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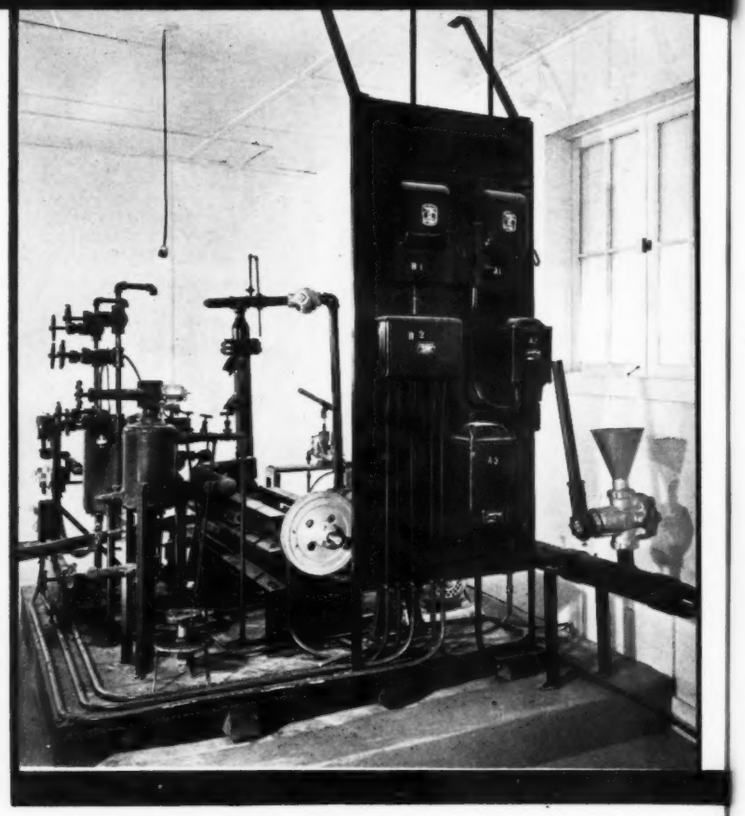

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Article 18

FLOW OF LIQUIDS IN PIPE LINES (Part VII)

Available Friction Head

THE difference in the elevations of the hydraulic gradient at both ends of the station district will give the head lost in pipe friction together with the loss of head due to the fittings in the line at the gate plants.

If the elevation of the pressure gauge in the discharge manifold at station A is 875 ft. we have:

$$875 + 1797 = 2672 \text{ ft.}$$

for the elevation of the hydraulic gradient at Station A.

Now if the elevation of the surface of the oil in the working tank at station B is assumed to be the elevation of the hydraulic gradient in the receiving manifold at station B, (this assumption is correct provided there is no flow between the receiving manifold and the working tank as is usually the case since both stations run even during normal pumping conditions) then the difference in the elevations or:

$$2672 - 1015 = 1657 \text{ ft.}$$

is the combined friction heads of the three sections including the friction loss due to the fittings in the two gate plants.

The net available head remaining that is consumed in the pipe itself will be:

$$1657 - 3.2 = 1653.8 \text{ ft.}$$

if 1.6 ft. is allowed for the drop in the hydraulic gradient at each of the gate plants.

Viscosity of the Liquid

The viscosity of crude oils in the Mid-Continent fields is usually determined in a relative way on an arbitrarily chosen instrument known as the Saybolt Universal Viscosimeter, an instrument devised primarily for the classification of oils by the refiner.

Such an instrument gives viscosity values that would be useless to the pipe-line engineer if a relation had not been established making it possible to compute the corresponding kinematic viscosity in centipoises or in the ft-lb. English units.

The kinematic viscosity in centipoises was adopted by the writer a number of years ago because it is an abstract number. Its value for water at 68 deg. fahr. is practically unity, whereas the kinematic viscosity in the English ft-lb. units is a concrete number.

To determine the kinematic viscosity in centipoises for the coldest line temperature in the winter when the temperature-viscosity curve of this particular oil gives a viscosity of 98.5 Saybolt universal seconds for a line temperature of 35 deg. fahr., we have by Equation 7,

$$k = 0.216 \times 98.5 - \frac{180}{98.5} = 19.44$$

as the desired viscosity to use in the discharge equation.

The value of k^w appearing in the Hagen discharge equation represents the specific viscosity; that is, the ratio of the head for a given liquid to the head of water at 68 deg. fahr. for equal rates of flow.

Computed Discharge of the District

When the discharge is computed by the Hagen formula we find that the coefficient and the exponents are independent of the discharge; therefore, Equation 5 (p. 78, August issue) may be transposed to solve for the discharge as:

$$B = \sqrt[n]{\frac{2g\,b\,N^n\,D_0^s}{A b\,M_0\,k^w}} \quad \ldots\ldots\ldots \quad (22)$$

in which:

$$A = \frac{5280 \times 12^{1.25}}{3.497^{1.75}} = 13186$$

$$\log \text{ of } 13186 = 4.1201137$$

when the writer's exponents are used.

We now have:

$2g = 64.32$	$M_0 = 6.61942$
$b = 1653.8$	$k = 19.44$
$N = 1$	$n = 1.75$
$D_0 = 12.00$	$x = 1.25$
$A = 13186$	$w = 0.25$
$b = 0.018168$	$s = (2n + x) = 4.75$

to substitute in Equation 22, as follows:

$\log 2g =$	1.8083460	$\log A =$	4.1201137
$\log b =$	3.2184830	$\log b =$	*8.2593071
$\log N^n =$	0.000	$\log M =$	0.8208199
$\log D^s =$	5.1261107	$\log k^w =$	0.3221741
	10.1529397		3.5224148

and:

$$10.1529397 - 3.5224148/1.75 = 3.7888656$$

$$= \log \text{ of } 6149.87 \text{ the discharge in bbl./hr.}$$

Value of the Argument

It has been assumed in the computations made thus far that the flow in each section of the station district was turbulent. To be on the safe side it is best to determine the values of the argument for each of the sections before proceeding further.

SECTION 1—

$$\left(\frac{B}{DKN}\right)_1 = \frac{6150}{12 \times .1944 \times 2.6444} = 996.9$$

SECTION 2—

$$\left(\frac{B}{DKN}\right)_2 = \frac{6150}{12 \times .1944 \times 2.99165} = 881.2$$

SECTION 3—

$$\left(\frac{B}{DKN}\right)_3 = \frac{6150}{12 \times .1944 \times 3.33055} = 791.6$$

Since these values are far greater than the value of the argument that determines which set of exponents and coefficients to use, our computations for turbulent flow are in the right direction.

In clean wrought-iron and steel pipe lines streamline flow may exist when values of the argument B/DKN are as high as 90, and turbulent flow may exist until the value of the argument is as low as 53. Between these values either streamline or turbulent flow may exist, depending upon whether the turbulent flow is being gradually decreased or the streamline flow gradually increased.

For pipe flow computations, using the Hagen formula with the writer's coefficient and exponents for either the streamline flow or for the turbulent flow, the value of the argument B/DKN of 53 is the value that determines the selection of the coefficient and its exponents to use in the formula; however, both regimes may be experienced when the discharge and viscosity produce a value of the argument between 53 and 90. This region is a very good one to keep out of in the design of a pipe line system.

In the operation of a system where the value of the argument B/DKN is between 53 and 90, the discharge will increase when starting up in proportion to the effective head until the maximum pump pressure is attained and this discharge may continue for several hours, when, for no apparent reason, the discharge will drop several percent as though a leak had occurred in the line. Such a change in discharge takes place when the flow changes from streamline to turbulent, but, nevertheless, the dispatcher is not relieved of the possibility of a leak until the line is completely covered throughout the entire station district. Hence the uncertainty experienced in the operation of such a flow condition should be sufficient reason for the engineer making certain his computations will give values of the argument well below 53 or above 90.

Friction Head for Each Section

The equivalent length of each section of the station district for one 12-in. line has been computed, the total of which was found to be 6.61942 equivalent miles. By dividing 1653.8 ft., the total pipe friction head, by 6.61942 we obtain:

$$\begin{aligned} \log\ 1653.8 &= 3.2184830 \\ \log\ 6.61942 &= 0.8208199 \\ \log\ 249.84 &= 2.3976631 \end{aligned}$$

249.84 ft. as the friction head per equivalent mile of one 12-in. line, and to determine the friction head for each section we have:

SECTION 1—

$$249.84 \times 2.73539 = 683.4 \text{ ft.}$$

SECTION 2—

$$249.84 \times 2.05724 = 514.0 \text{ ft.}$$

SECTION 3—

$$249.84 \times 1.82679 = 456.4 \text{ ft.}$$

from which we may now determine the elevation of the hydraulic gradient at the gate plants.

Elevation of the Hydraulic Gradient

At the beginning of this article it was shown that the elevation of the hydraulic gradient at Station A was 2672 ft., and at Station B, 1015 ft., from which the intermediate points, or gate plants, will now be determined.

A very good practice is to start at the down-stream end of the station district and back up to the station pumping.

If 1015 is the elevation of the hydraulic gradient in the receiving manifold at Station B, and 456.4 ft. is the pipe friction loss in Section 3, their sum, or

$$1015 + 456.4 = 1471.4 \text{ ft.}$$

is the elevation of the hydraulic gradient leaving the gate plant at the beginning of Section 3.

It was previously decided that a 1.6-ft. offset in the hydraulic gradient at the gate plants would cover the loss due to the fittings in the gate plant, then:

$$1471.4 + 1.6 = 1473.0 \text{ ft.}$$

is the elevation of the hydraulic gradient entering the gate plant at the end of Section 2.

The pipe friction head in Section 2 was determined as 514.0 ft., and, when added to the elevation of the hydraulic gradient at the end of Section 2, we have:

$$1473.0 + 514.0 = 1987.0 \text{ ft.}$$

as the elevation of the hydraulic gradient leaving the gate plant at the beginning of Section 2, and:

$$1987.0 + 1.6 = 1988.6 \text{ ft.}$$

is the elevation of the hydraulic gradient entering the gate plant at the end of Section 1.

The pipe friction head in Section 1 was determined as 683.4 ft., and, when added to the elevation of the hydraulic gradient at the end of Section 1, we have

$$1988.6 + 683.4 = 2672.0 \text{ ft.,}$$

the elevation previously determined for the hydraulic gradient at the beginning of Section 1 at Station A.

Pressure Gauge Readings at Gate Plants

The difference between the elevations of the hydraulic gradient and the elevations of the pressure gauges will give the head in feet of liquid above the center of the pressure gauge. By transposition of Equation 6 we have for the gauge pressure:

$$P = \frac{61.287\,h}{(131.5 + G)} \quad \ldots\ldots\ldots \quad (6a)$$

The gauge pressure at each of the gate plants (Nos. 1 and 2) should always be known, and the gauge pressure at the lowest point in a deep inverted syphon should be known for the purpose of determining the required strength of the pipe to be used as well as for operating purposes.

At Gate Plant No. 1 the elevations of the hydraulic gradient have been computed as 1988.6 ft. and 1987.0 ft., respectively, and the elevation of the pressure gauges at this gate plant determined as 1050.0 feet. The difference in the elevations will give 938.6 ft., and 937.0 ft., as the two pressure heads in feet of liquid, and, when substituted in Equation 6a, they result in 339.4 and 338.8 as the gauge pressures in lb. per sq inch.

At Gate Plant No. 2 the elevations of the hydraulic gradient were determined as 1473.0 ft. and 1471.4 ft., respectively, and if the elevations of the pressure gauges are taken as 1110.0 ft., the difference in the elevations will give 363.0 ft., and 361.4 ft., for the head in ft. of liquid, and when substituted in Equation 6a they result in 131.3 and 130.7 as the gauge pressures in lb. per sq. inch.

Multi-Flame LINDEWELDING

A close-up of the Multi-Flame Lindewelding Head in action. Two small flames underneath the head preheat the vee ahead of the weld, thus increasing, tremendously, the rate of welding.

Speeds Up Laying of Pipe Line . . . 50%

As a test, 10 miles of 8-in. pipe—part of a 54-mile pipe line job—were laid by Multi-Flame Lindewelding. This test section was Lindewelded in three days—with an average of 304.6 welds a day for six welders, a 50 per cent increase in speed over other methods of welding.

The big jump in production through Multi-Flame Lindewelding assured its use on the remaining 30-mile section of 6-in. line. Here six welders averaged nine welds each per hour . . . also an increase of 50 per cent in speed over single flame heads.

Multi-Flame Lindewelding is a new method of oxy-acetylene welding involving a special flame adjustment, the Oxweld No. 24 Lindeweld Process Welding Rod, and the new Multi-Flame Lindeweld Head. It was developed by the Linde engineering and research organizations and was brought to this job as a part of Linde Process Service. This same service is available to Linde customers everywhere.

Ask any Linde Office for information on Multi-Flame Lindewelding. They are in Atlanta—Baltimore, Birmingham, Boston, Buffalo, Butte—Chicago, Cleveland—Dallas, Denver, Detroit—El Paso—Houston—Indianapolis—Kansas City—Los Angeles—Memphis, Milwaukee, Minneapolis—New Orleans, New York—Philadelphia, Phoenix, Pittsburgh, Portland, Ore.—St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

Everything for Oxy-Acetylene Welding and Cutting

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FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

IS THIS plastered mud HOLDING BACK YOUR OIL?

Not Cleaned With a Baker Rotary Wall Scraper. *The coating of rotary mud prevents the free flow of oil out of the sand and into the hole.*

Remove All Rotary Mud With The BAKER ROTARY WALL SCRAPER

Good plastic and wall-forming qualities in rotary mud offer many advantages while you are drilling. But when it comes time to produce your well, that very mud, plastered over the face of the oil sand, often holds back production, clogs your screen pipe and cheats you out of a large share of the production you should get.

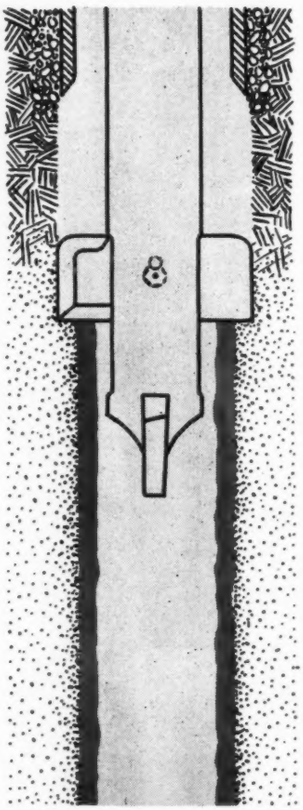
The modern way to assure yourself that your well will be in condition to produce freely is to remove the sheath of rotary mud with a Baker Rotary Wall Scraper—BEFORE PUTTING THE WELL ON PRODUCTION. At the same time you can, if desired, ENLARGE the hole through the oil zone and provide a greater reservoir for the accumulation of oil, and greater clearance for the liner.

The amazing expansion of the blades of the Baker Rotary Wall Scraper enables them to do a thorough job. You can cut to any specified diameter in ¼-inch steps up to the capacity of the size of tool in use. For instance, a No. 3-A Wall Scraper will run in through 6⅝-inch casing and scrape to any desired diameter from 6 to 11 inches.

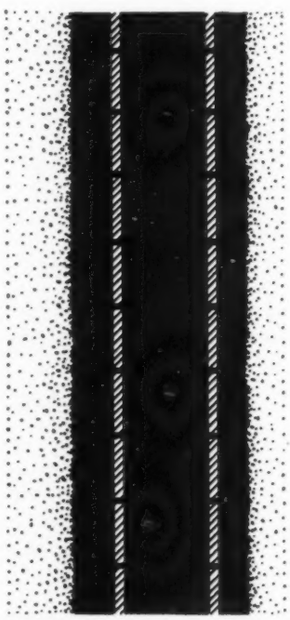
This easy, economical, SAFE method of preparing wells for production has proved so successful that every year more operators, everywhere, are adopting it. Why not try it out yourself?

Always use the BAKER ROTARY WALL SCRAPER to secure these important advantages

- When Underreaming for setting Liners and Casing—allows larger sized liners and casing to be run in easily.
- When Underreaming BEFORE Cementing—gives shoe-point sufficient clearance to permit complete cement distribution and stronger bond with formation, by underreaming last 25 or more feet to bottom; as described above.
- When Correcting Deviations from the Vertical—straightens crooked holes by creating a wide shoulder for NEW start. When Cementing Combination String—enlarges hole opposite section to be cemented—provides excellent condition for successful C. P. job.
- When Cleaning Out Old Wells—enlarges and cleans productive area by wall-scraping to larger diameter.
- When Bottom Water Shut-Off Fails—Wall Scrape to size of original hole or larger (after drilling out old cement)—then re-cement.



This is the way the blades of the Baker Rotary Wall Scraper cut plastered mud from the face of the producing sand and enlarge the hole. Wells that are thoroughly cleaned with the Wall Scraper are put in condition to give a better yield for a longer period because the pores of the sand are opened, and when desired a larger reservoir is provided.



Thoroughly Cleaned with a Baker Rotary Wall Scraper. A CLEAN formation, and LARGE reservoir (when desired) assure the most favorable producing condition.

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See your 1936 COMPOSITE CATALOG for Complete Details

BAKER ROTARY WALL SCRAPER

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

Hubby: Let's go out and have some fun.

Wife: All right. If you get in before I do, leave the hall light on for me.

* * *

Peevish Wife: You think so much of your old football, you don't even remember when we were married.

Husband: Don't I? It was the day Morgan College beat Preston 7 to 2.

* * *

A young sailor was cast away on a desert island. After he had been there for nine years, he espied a figure on a neighboring island. Braving the sharks, he swam there to find a sweet young woman awaiting him. Approaching her, he said:

"How long have you been here?"

"Why, I've been here six years," she said.

"Six years. Why, I've been on my island for nine long years."

"Why, you poor man, all alone for nine years. I'm going to give you something you've been wanting for a long time."

"Lady, you don't mean to tell me you've got beer on ice?"

* * *

"Why did you name your boy Clarence Algernon James?

"Well, I want him to be a prize fighter, and any boy with a name like that gets lots of practice."

* * *

A young bride walked into a drug store and approached a clerk timidly.

"That baby tonic you advertise," she began, "does it really make babies bigger and stronger?"

"We sell lots of it," replied the druggist, "and we've never had a complaint."

"Well, I'll take a bottle." She paid for it and walked out.

Five minutes later she was back. She got the druggist into a corner and whispered in his ear: "I forgot to ask you about this baby tonic, Mister. Who takes it—me or my husband?"

* * *

No Favors

Son: Say, Dad, that apple I just ate had a worm in it, and I ate that, too.

Parent: What! Here, drink this water and wash it down.

But Junior shook his head. "Aw, let 'im walk down."

"Hello! Hello!" cried an excited feminine voice over the telephone, "come at once. Two men are trying to climb into our window."

"Sorry, Miss, but this is the fire department."

"Well, our room is on the second floor and they need a ladder."

* * *

"Obey That Impulse"

An executive who is a great believer in efficiency hung up a sign in his office one day last week. It said, "Do It Now." Within 24 hours the cashier had bolted with the contents of the safe, his stenographer eloped with his oldest son, the office boy threw the ink bottle into the electric fan, and the whole office force struck for a six-hour day.

* * *

"Oh, Mrs. Flatbottom, I have never seen a child as badly spoiled as that son of yours."

"Why, Mrs. Murphy, how can you say that?"

"Just come out and see what the fire engine done to him."

—*West Point Pointer.*

* * *

Couldn't Stay Put

Driving through the mountainous Cabin Creek district in West Virginia, a tourist noticed a man with plow and team lying in the road.

"What happened?" asked the tourist.

The old farmer jerked a thumb upward and ejaculated: "Doggone it, I'm going to quit plowin' in that co'n field up thar. That's the third time I've fell out of it today."

* * *

"What is the most wonderful thing in the world?"

"The most wonderful thing in the world is Mae West."

"No. The most wonderful thing in the world is sleep."

"Yes, sir, next to Mae West."

* * *

Prof. Hercules Strongarm,
Strongarm Correspondence School of Physical Culture,
Fifth Avenue, New York.
Dear Prof. Strongarm:

I have completed your course. Kindly send muscles.

Yours truly,
Marvin Milquetoast.

—*Exchange.*

Mountaineer: Thar's a revenooer.

Same: Yeah, see ef ya kain't git thet rabbit with the same shot.

* * *

A fellow was telling me about taking his girl to a barn dance recently. He said she gave him the same old stall.

* * *

"Judge," said the funny prisoner, "give me a sentence with the word freedom in it."—*Temple Owl.*

* * *

"I guess you've gone out with worse looking fellows than I am, haven't you?"

(No answer.)

"I say, I guess you've gone out with worse looking fellows than I am, haven't you?"

"I heard you the first time. I was trying to think."

* * *

We once knew a man who was so crooked that the wool he pulled over your eyes was half cotton.

* * *

He: We're going to have a swell time tonight. I've got three seats for the theater.

She: Why do we need three seats?

He: They're for your father, mother, and kid brother.

* * *

Old Lady: I suppose you and your husband worry a lot that you have not had any children?

Young Lady: Oh, yes. We've spent many a sleepless night over it.

S. Calif. Wampus.

* * *

"Mr. Jones left his umbrella again. I do believe he would lose his head if it were loose."

"I dare say you're right. I heard him say only yesterday that he was going to Colorado for his lungs."

* * *

Go to It, Vicar

A kind-hearted English vicar one day observed an old woman laboriously pushing a perambulator up a steep hill. He volunteered his assistance, and when they reached the top of the hill said, in answer to her thanks:

"Oh, it's nothing at all. I'm delighted to do it. But as a little reward, may I kiss the baby?"

"Baby, Lor' bless you, sir," she returned, "it ain't no baby, it's the old man's beer."

HAROLD P. SANDERS, assistant resident chemist at the Marcus Hook, Pennsylvania, refinery of the Pure Oil Company, has been transferred to the Cabin Creek, West Virginia, refinery as resident chemist. His post at Marcus Hook has been taken over by **LEON A. McDOWELL,** transferred from the Heath refinery at Newark, Ohio.

ARTHUR T. ROBERTS has been elected treasurer of the Socony-Vacuum Oil Company, Inc., New York, New York, succeeding **F. S. FALES,** vice-president, director, and member of the executive committee.

JACK CLOVER has been made production superintendent for the Wilcox Oil and Gas Company, Tulsa. He succeeds **W. J. MORRISON,** who died recently from injuries sustained in an automobile accident near Pampa, Texas. Clover had been assistant production superintendent.

A. C. RUBEL, manager of production of the Union Oil Company of California, Los Angeles, recently was elected chairman of the executive committee of the advisory council of the College of Engineering, University of Southern California. The function of the committee is to promote the attainment of a high order of engineering training at the institution and also to aid in the placement of graduating students.

FORREST E. LOVE has resigned as district treating engineer for the Phillips Petroleum Company at Seminole, Oklahoma, to take a position with the Tretolite Company of St. Louis, Missouri, as sales engineer. He will make his headquarters at Shawnee, Oklahoma.

C. H. LIEB, president of the Carter Oil Company, Tulsa, subsidiary of the Standard Oil Company of New Jersey, has announced the following promotions, effective as of January 1st: **GEORGE H. LANG,** vice-president and executive assistant to the president, has been made assistant to **EUGENE HOLMAN,** manager of producing properties of the Standard Oil Company of New Jersey, with headquarters in New York City; **J. J. CONRY,** vice-president and manager of production, becomes vice-president and executive assistant to the president, with headquarters in Tulsa, Oklahoma; **F. W. FLOYD,** assistant manager of production, was promoted to manager of production, with headquarters in Tulsa; **R. L. CLIFTON,** Oklahoma City, superintendent of the central division, has been transferred to the Seminole district as superintendent to succeed **SAMUEL W. EMERY,** retired after 25 years' service; **J. K. ELLIS,** assistant superintendent at Oklahoma City, was made superintendent of the central division; and **WILLIAM A. WATKINS,** production foreman at Oklahoma City, is now assistant superintendent there.

CHARLES B. JOHNSON, petroleum engineer, has been transferred from Louisiana to the Oklahoma City field by his company, the British American Oil Producing Company.

R. V. HIGGINS, recently with the United States Bureau of Standards, is now with the United States Bureau of Mines, San Francisco, California, engaged in petroleum and natural gas studies.

DR. EMORY KEMLER and **R. L. KIRKPATRICK,** of the Gulf Research and Development Corporation, Pittsburgh, Pennsylvania, have returned to their headquarters, following some time spent in Texas, where they made studies of production practices in West Texas and the Panhandle.

P. L. McGEE, petroleum engineer with the Humble Oil and Refining Company, has been transferred from the Dickinson field, Texas, to the Thompson, Texas, district.

KIRBY S. WOOLERY, chief engineer of the Magnolia Petroleum Company, Dallas, Texas, was retired on January 1st, after 40 years' service with the company, and passed away a week later. He is succeeded by **JOSEPH M. WILLIAMS,** who has been his assistant.

WILLIAM F. HUMPHREY, president of the Associated Oil Company, Los Angeles, California, has announced the following promotions in his organization: **H. T. EARL** from manager of transportation to the position of assistant vice-president of the transportation and engineering department. **H. B. HANEY,** who has been chief engineer of the company, succeeds Earl as manager of transportation in charge of the pipe line, marine, traffic, and automotive departments. **I. G. REED,** assistant chief engineer of the company, was appointed chief engineer to succeed Haney. **L. C. DECIUS,** chief geologist, has been appointed general manager of the producing division in charge of all drilling and production activities of the production department which is headed by Vice-President **J. H. JENKINS. MARTIN MEARS,** superintendent of the Ventura and Santa Maria divisions, assumes full charge of all drilling operations for the company, in addition to his present duties. **F. W. HERTEL** was appointed assistant superintendent of the Ventura and Santa Maria divisions. **F. A. MENKEN,** petroleum engineer, succeeds Decius as chief geologist in charge of all exploratory geological activities.

NORVAL F. MYERS has been made manager of the Oleum refinery of the Union Oil Company of California. He was assistant manager. **A. ROY HEISE,** former manager, has been transferred to Los Angeles as supervisor of operations, refineries department.

WILL REID, president of the Hancock Oil Company, Los Angeles, California, is back at his desk, having fully recovered from his recent illness.

SIR JOHN CADMAN, chairman of the Anglo-Iranian Oil Company and the Iraq Petroleum Company, has been re-elected president of the Institution of Petroleum Technologists.

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Unit Type Draw Works

NO. 34·32·9·DMU

PORTABILITY: Heavy welded structural steel frame permits entire draw works to be moved as a unit.

BRAKES: Compound Equalizing capable of handling heaviest loads.

BRAKE RIMS: 54-inch diameter by 10⅜-inch wide water cooled brake rims furnished on order. Life of rims and lining and braking efficiency greatly increased by effective cooling of braking surfaces.

DRUM: 32-inch diameter by 35¼ inch long grooved drum with ample capacity for longest drilling lines.

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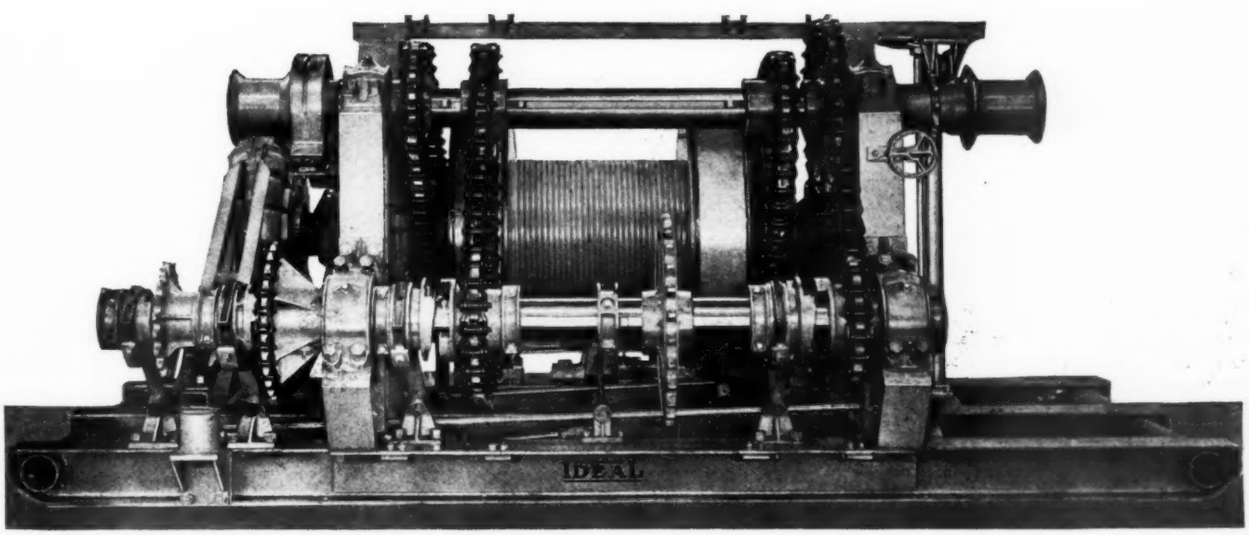
ROTARY DRIVE: From clutch sprocket mounted outside of bearing on Jack Shaft thru roller bearing idler sprocket on drum shaft. This affords unusually low drive to the rotary.

THE NATIONAL SUPPLY COMPANY



Texas Chemists Utilize Oat Hulls to Refine Oil

By J. C. WATKINS

THE next time you order a quart of oil at the corner filling station you may be buying a lubricant refined by a chemical derived from the husks of oats you ate for breakfast.

This latest wrinkle in making high-grade lubricants has been put into operation at the Gulf Refining Company's plant at Port Arthur, Texas.

The chemical, known as Furfural, has an affinity for some components of lubricating stocks and an antithesis for others.

Refining experts agree that all crude oils contain the same chemical elements in greater or less proportions, and the same principle holds true of lubricating stocks originating from such crudes.

The refining art now has developed to the point where selective solvents such as Furfural may be applied successfully to separate the good from the bad in lubricating stocks.

This application is being carried out at the Gulf's Port Arthur refinery where a new unit utilizing this process has just been completed. The procedure involves pumping unrefined lubricating stocks upward in a vertical tower in counter passage with the down-flowing selective solvent.

As the oil stocks and the Furfural pass in the tower, the Furfural selectively dissolves the resinous undesirable components from the lubricating stock, setting free those components having the characteristics desirable for a superior lubricant.

This Furfural solution of the resinous portion, being of higher specific gravity, settles continuously to the bottom of the extraction tower while the lighter layer containing the valuable lubricating portion rises to the top.

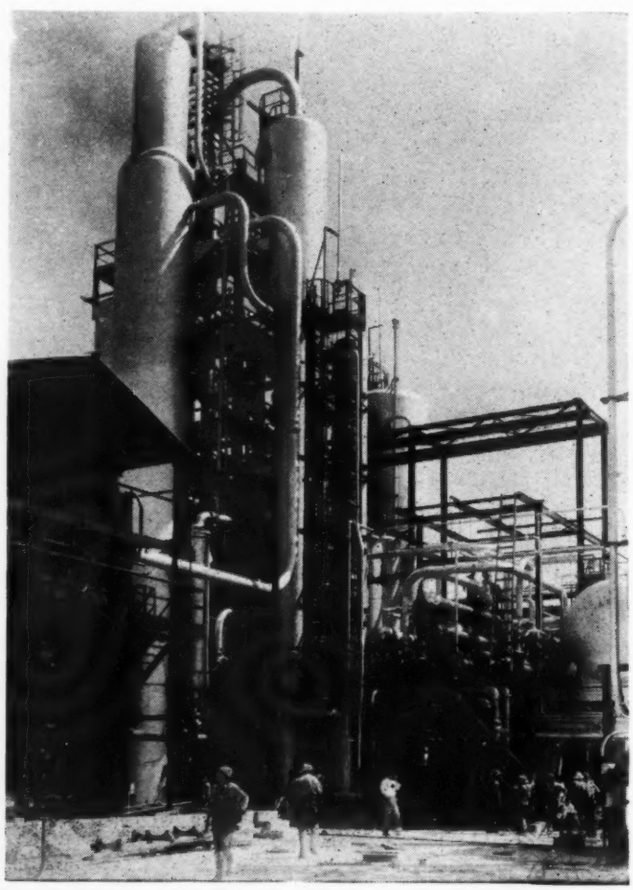
The heavier layer, designated as "extract", is drawn from the bottom and the lighter layer called "raffinate" flows out through the top of the tower.

The Furfural then is removed from the extract and raffinate layers by distillation and returned to the process for re-use. The extract may be used for fuel and the raffinate, freed of solvent, is the desired lubricating oil. This then is processed through additional steps to produce the various commercial grades of lubricating oils.

In accomplishing this scrubbing action, the Multi-Sol process, as it is termed, produces an exceptionally high-quality lubricating oil, chemists say.

The new 5000-bbl. unit consists of an extraction tower and a maze of heat exchangers, heaters, and coolers, all required for the economical operation of the separating and recovery processes.

Viscosity Index—that's the current term most widely used in evaluating the quality of lubricating oils—and Multi-Sol refining is one of the chemical engineer's latest means for meeting modern demands for high-viscosity index oils.



Intricacies of modern oil refining may be realized by a glance at this picture—a view of the Multi-Sol unit just completed at the Gulf Refining Company refinery at Port Arthur, Texas. Furfural, a substance derived from the husks of oats, is used to scrub out the impurities in oils in the tall extraction towers. Some indication of the size of the apparatus may be obtained by comparison with the figures of men in the foreground.

Exhibitors for Petroleum Exposition Already Number 432

Four hundred and thirty-two exhibitors, including the major supply houses, equipment manufacturers, and oil service concerns, have signed for 92 percent of the 180,000 sq. ft. of booth and open air exhibit space for the ninth International Petroleum Exposition, according to W. B. Way, general manager.

Oil associations are setting meetings in Tulsa to be held in connection with the Exposition and already four have scheduled events: the spring meeting of the American Petroleum Institute, Independent Petroleum Association of America; National Stripper Well Association, and Natural Gasoline Association of America.

"Twenty-one nations that produce 99 per cent of the world's oil have been invited to send exhibits to the Exposition. Geological maps of its oil territory and methods of production, transportation, refining, and marketing will be shown in order that the oil men from each country may exchange ideas," says Way.

The countries invited to show include: Roumania, Poland, Russia, Venezuela, Colombia, Argentina, Peru, Persia, India, Dutch East Indies, Mexico, Equador, Bolivia, Japan, Sakhalin (Asia), Iraq, British Borneo, Egypt, Canada, and the United States.

Harry LeVan Horning Dead

Harry LeVan Horning, founder and president of the Waukesha Motor

HARRY LE VAN HORNING

Company, Waukesha, Wisconsin, died at Battle Creek Sanitarium January 4th. He was 55 years old, and had been at the Battle Creek health resort for two months undergoing treatment.

In April, 1906, in company with local business associates, he organized the Waukesha Motor Company, and became its chief engineer and general manager.

National prominence came to him when he was chairman of the Automotive Section of the War Industries Board, and served as a dollar a year man. It was his committee that produced the design for the Class B Liberty army truck, and into this work he took other members of his organization who served with him.

Horning was a past president and life member of the Society of Automotive Engineers, member of the Automotive Engineering Society of Great Britain, the American Society for Testing Materials, past president of the Motor and Equipment Manufacturers Association, the first president of the Internal Combustion Engine Institute, director of the Automotive Parts & Equipment Manufacturers Association, a member of the American Petroleum Institute, and the National Association of Manufacturers. He was a graduate of Carroll College and a member of the board of trustees of that institution. He was technical advisor to the Waukesha Vocational Schools and the Milwaukee School of Engineering.

Speaking of
FLEXIBILITY

Have you seen the Chiksan Joints for ship loading, discharging and loading racks? Their specially designed packing sets provide a more positive seal with less friction from moving parts. Ball bearings serve two purposes. They provide easy swiveling and lock the various rotating sections together. All moving parts are Alemite lubricated. Chicksan Joints will last indefinitely. Manufactured in six different styles. Sizes up to 8" carried in stock. Larger sizes on order.

Our engineers will be glad to submit information and designs covering particular problems, wherein the use of flexible joints are indicated.

NO. 60 DOCK RISER
(2-WAY SWIVEL
MADE WITH FLANGED OR THREADED ENDS)

Chiksan
CHIKSAN OIL TOOL CO. LIMITED
FULLERTON, CALIFORNIA — GULF ENGINEERS INC., HOUSTON, TEXAS
PACIFIC NORTHWEST DISTRIBUTOR — E. C. GRIFFIN [illegible] AVE. NORTH, SEATTLE, WASH.

Joseph S. Reid, Head of Clark Bros. Co., Passes Away

Joseph Snively Reid, president and treasurer of Clark Brothers Company, Olean, New York, since 1923, passed away at his country home in Belmont, New York, December 20. He had been in failing health for the past year.

Reid was born at Greencastle, Pennsylvania, December 5, 1868, and became connected with Clark Brothers Company in 1892. His first position was in the pattern department and, manifesting a marked engineering ability, his advancement was rapid until eventually he became head of the organization.

He displayed interest in many matters other than those immediately concerned with his work. He was studious by nature and a self-educated man. Much of his time was devoted to astronomy and in his home he had one of the largest and best equipped amateur observatories in New York State. He took courses at Columbia University when opportunity afforded itself, and was considered an authority on mechanical devices. He was responsible for the development of the sawmill machinery at Clark Brothers Company's plant.

Surviving are his widow, Mrs. Gertrude Pike Reid; two sisters, Mrs. George Leman and Miss Alice Reid, of Hagerstown, Maryland; and a neice, Mrs. Robert Porter, of Jackson Heights, Long Island.

Mid-Continent District of A.P.I. to Meet at Wichita, Kansas

The Mid-Continent District of the American Petroleum Institute, Division of Production, will hold its annual meeting in Wichita, Kansas, February 20 and 21, at the Allis Hotel.

G. A. Holloway, chairman of the program committee, has announced the following tentative list of subjects that will be discussed:

"Salt Water Disposal."

"Water Flooding in Mid-Continent Area" (dealing with recent water flooding in Oklahoma fields and its possible application to Kansas Lenticular fields).

"Gas Repressuring in Eastern Kansas."

"Methods of Calculating Required Horsepower for Pumping Wells."

"Power Equipment for Rotary Drilling, Engine and Engine-Electric."

"Electric Coring and Its Value in Mid-Continent Drilling Operations."

"Drilling and Production Practices in the Oklahoma City Field."

"Symposium on Corrosion of Lease Equipment in Sour Oil Producing Areas."

"Effect of Reservoir Performance on Future Oil Recovery."

"Trend of Surface Pumping Equipment in Mid-Continent Fields."

George H. Reid Succeeds Fred S. Hartman at G-E

George H. Reid has been appointed industrial department manager of the General Electric Company's New York district, succeeding Fred S. Hartman, who retired at the close of the year, according to a recent announcement made by H. H. Barnes, Jr., commercial vice-president of the company. The appointment became effective January 1, 1936. Hartman's services, Barnes stated, will still be available to the company in an advisory capacity.

NATIONAL BANK OF TULSA

NBT

Statement of Condition December 31, 1935

RESOURCES

Cash and Due from Banks	$ 20,407,643.83	
U. S. Government Securities	13,309,557.95	
Other Bonds and Warrants	3,326,247.44	$ 37,043,449.22
Loans and Discounts		15,430,113.94
Overdrafts		2,136.00
Income Receivable Accrued		141,572.77
Stock in Federal Reserve Bank		240,000.00
Investment in Bank Premises		2,206,000.00
Customers' Liability Under Acceptances		5,773.00
TOTAL		$ 55,069,044.93

LIABILITIES

Deposits		$ 46,600,899.11
Acceptances Executed		5,773.00
Income Collected not Earned		57,957.89
Interest, Taxes, etc., Accrued		60,210.54
Capital—Preferred	$ 4,000,000.00	
Capital—Common	2,000,000.00	
Surplus	2,000,000.00	
Undivided Profits and Reserves	344,204.39	8,344,204.39
TOTAL		$ 55,069,044.93

COMPARATIVE DEPOSITS

December 31, 1933	$ 28,016,837.43
December 31, 1934	37,292,321.66
December 31, 1935	46,600,899.11

NATIONAL BANK OF TULSA

TULSA, OKLAHOMA

The Oil Bank of America

TRADE LITERATURE

THE CARBIDE AND CARBON CHEMICALS CORPORATION, 30 East 42nd Street, New York City, has issued a bulletin announcing a unique, simple method for correcting leakage in gas distribution systems by the use of a specially developed liquid composition called "Carboseal." Carboseal is the result of several years research and development. The solution is said to correct leakage in packed bell and spigot joints by moistening and swelling the jute packing, and lay dust in the mains. Carboseal can be applied without interrupting gas service, it is stated.

* * *

JON R. LONG, successor to Petroleum Equipment Company and Oil Field Engineering Corporation, Fort Worth, Texas, has issued Catalog 5 covering a complete line of pumping and gas lift equipment. It is now available for free distribution.

R. R. Davis Promoted

R. R. Davis, formerly assistant manager of the advertising department of Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pennsylvania, succeeds Ralph Leavenworth, who resigned as manager as of January 1, 1936, according to announcement by N. G. Symonds, vice-president. Leavenworth will join Fuller & Smith & Ross, Cleveland, advertising agency that handles the Westinghouse account.

Taubman Supply Corporation Expanding Service

The Taubman Supply Corporation of Tulsa, Oklahoma, has launched an expansion program that will enable the company to give improved service to oil men of Kansas, Oklahoma, and Texas. An office is being opened at Dallas, Texas, and new field stores at Wichita and Russell, Kansas, in addition to the enlarging of office space in the National Bank of Tulsa Building in Tulsa.

C. C. Crider, assistant to President H. P. Taubman, is being sent to Dallas as executive vice-president. Guy A. Tompson, formerly general purchaser of the Empire Companies at Bartlesville, Oklahoma, has been made sales manager and will have his headquarters in Tulsa.

Shand & Jurs Company Open Office at Houston, Texas

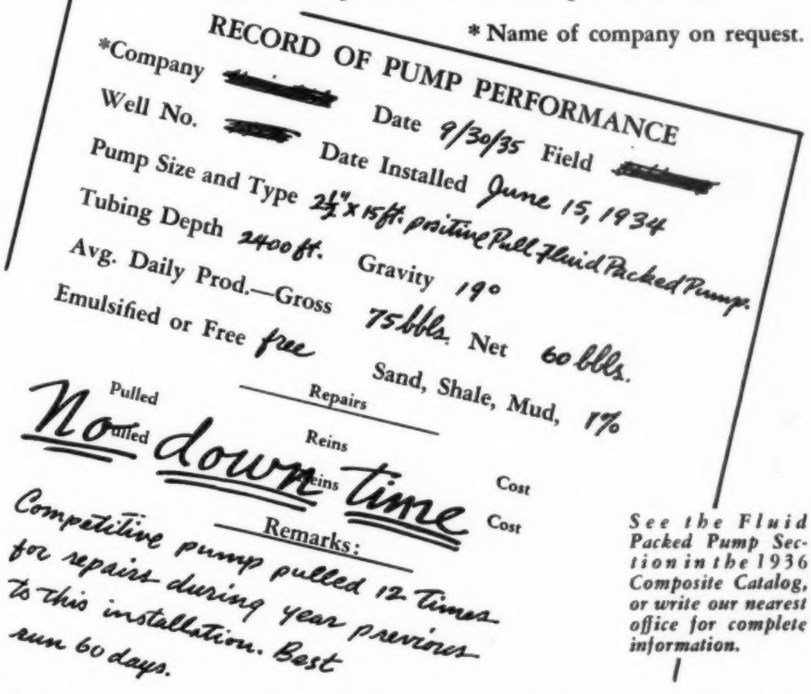
As a part of an expansion program, Shand & Jurs Company, Berkeley, California, manufacturers of petroleum storage tank fittings and internal hydraulic valves for tank trucks, announces the opening January 1st of a Southwestern Division office in Houston, Texas, which is under the management of Joseph Z. Hertzler, a technically trained engineer, well qualified by previous experience to hold this important post.

Establishment of this branch office presages the ultimate warehousing of Shand & Jurs products in Houston, in order to render the petroleum industry in Texas and Mid-Continent fields a better service on S. & J. tank fittings.

No Down Time!

The notation "NO DOWN TIME" on a pumping well record means more production at a lower cost per barrel. It is a familiar notation on records of wells using Fluid Packed Pumps. Here's one that speaks for itself:

* Name of company on request.


RECORD OF PUMP PERFORMANCE
*Company [redacted]
Date 9/30/35 Field [redacted]
Well No. [redacted]
Date Installed June 15, 1934
Pump Size and Type 2½" x 15ft. pristine Pull Fluid Packed Pump.
Tubing Depth 2400 ft. Gravity 19°
Avg. Daily Prod.—Gross 75 bbls. Net 60 bbls.
Emulsified or Free free
Sand, Shale, Mud, 1%
Pulled
Repairs
No down time
Reins
Cost
Remarks:
Competitive pump pulled 12 times for repairs during year previous to this installation. Best run 60 days.

See the Fluid Packed Pump Section in the 1936 Composite Catalog, or write our nearest office for complete information.

FLUID PACKED PUMP CO.
BOX 64 • LOS NIETOS, CALIFORNIA • U.S.A.
MID-CONTINENT AND TEXAS DISTRIBUTION
FLUID PACKED PUMP CO.—MID-CONTINENT
2 S. E. 29TH ST., OKLAHOMA CITY, OKLAHOMA
Gulf Coast Headquarters: 409 Velasco St., Houston, Texas
London Office: Coventry House, South Place, London E.C. 2, England
A MODERN PUMP FOR MODERN CONDITIONS
Protected by Patents No. 1545474, 1545475, 1549175, 1621046: others pending.

EXACTLY

DETERMINING WHERE YOU ARE WITH THIS 2-WAY EASTMAN SERVICE

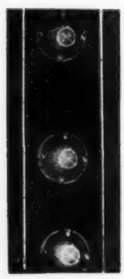
that is successfully guiding the destiny of drill holes all over the Oil World.

The MULTIPLE SHOT

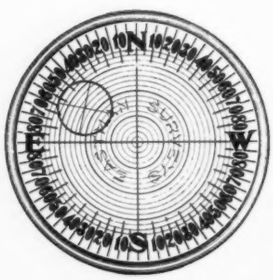
Gives you a perfect survey in any hole, cased or uncased . . . completed or partially drilled. No hole is too deep nor too small for an actual photo record of the hole all the way down.

The SINGLE SHOT

The most accurate survey in existence for open hole work. Photograph recording the angle and direction of deviation, at any desired depth, ready for checking within 5 minutes after Instrument is run.



Sample cutting from EASTMAN Multiple Shot photographic report.



EASTMAN Single Shot photographic disc, actual size.

The 1936 EASTMAN Catalog, covering full details of EASTMAN Instruments and Service, is now available. Write for your copy.

CONTROLLED DIRECTIONAL DRILLING — Eastman — OIL WELL SURVEY SERVICE

Eastman

OIL WELL SURVEY CO. of TEXAS

4909 Fannin Street, Houston, Texas

2895 American Ave., LONG BEACH

5 Stiles Park Circle, OKLAHOMA CITY

Clark Bros. Company Opens Dallas Office

Clark Bros. Company of Olean, New York, have opened an office at 2104 Magnolia Building, Dallas, Texas. Fred H. Hayes is district manager of the territory embracing Texas, Louisiana, New Mexico, and Arkansas. He has been transferred to Dallas from the East.

N.G.A.A. Program Committee Appointed

T. R. Goebel, Skelly Oil Company, president of the Natural Gasoline Association of America, has appointed the program committee for the 15th annual meeting of that organization, to be held in the Tulsa Hotel, Tulsa, Oklahoma, May 13, 14, and 15, as follows: George P. Bunn, Phillips Petroleum Company, Bartlesville, Oklahoma; R. E. Baker, Shell Petroleum Corporation, Tulsa; W. F. Fulton, United Gas Public Service Company, Houston, Texas; R. D. Gibbs, Union Oil Company of California, Los Angeles; W. B. Moran, J. E. Crosbie, Inc., Tulsa; and J. W. Vaiden, Skelly Oil Company, Tulsa.

The Natural Gasoline Association of America, as an accommodation to the American Petroleum Institute for its mid-year meeting, has shifted its meeting from the Mayo Hotel.

Kansas Chapter A.P.I. Meets

The Kansas Chapter of the A. P. I., Production Division, held its monthly meeting at Great Bend, January 10.

M. G. Ensinger, of the Union Wire Rope Company, gave an interesting talk on "The Uses and Abuses of Wire Rope."

The following were elected officers for the 1936 term: A. S. Ritchie, president, McPherson Drilling Company, chairman; Van D. Bennett, assistant general production superintendent, Derby Oil Company, first vice-chairman; G. A. Holloway, Kansas representative, Lee C. Moore & Co., second vice-chairman. Advisory board: H. K. Phipps, general superintendent pipe lines, White Eagle Oil Corporation; H. M. Williams, Kansas production superintendent, Marathon Oil Co.; T. J. Hamilton, Kansas production superintendent, Phillips Petroleum Co.; E. B. Pyle, independent producer; E. B. Shawver, independent producer; L. W. McLeod, Westinghouse Electric and Manufacturing Company; Dewey Jordan, Atlantic Oil Producing Company; and C. S. Warren, Kansas superintendent, Empire Oil & Gas Co.

Rushwold Oil Company Formed; Headquarters at Dallas

The Rushwold Oil Company has been organized at Dallas, Texas, with J. M. Rush as president, and E. H. Griswold as vice-president. Charles Denton is secretary-treasurer, and headquarters are in the Kirby Building.

E. H. GRISWOLD

Rush also is president of the Trinity Drilling Company and J. M. Rush, Inc., and is a well-known Mid-Continent operator, having production and drilling enterprises in several states. He was president of the Columbia Oil and Gas Company prior to the sale of that company's properties to the Stanolind Oil and Gas Company.

Griswold, who resigns as assistant general superintendent of production for the Texas-New Mexico division of the Continental Oil Company, has been identified with the industry in the Mid-Continent for a number of years. Following graduation from the Missouri School of Mines he was connected successively with the Amerada Petroleum Corporation, Comar Oil Company, and various drilling contractors. Later he was a petroleum engineer with the Pure Oil Company. In 1927 he became connected with the Marland Company and continued with its successor, the Continental Oil Company. During that time he has been variously a division petroleum engineer, assistant chief engineer, technical advisor to the president, and the last two years, as mentioned, assistant general superintendent of production for Texas and New Mexico.

J. C. Johnston, formerly district superintendent for Continental, most recently at Hobbs, New Mexico, succeeds to Griswold's vacated post.

David B. Crawford is New Head Parkersburg Rig and Reel Co.

David B. Crawford has been selected by the board of directors as president of the Parkersburg Rig and Reel Company to fill the post made vacant by the recent death of H. J. Lockhart. He has been associated with his brother, John M. Crawford, in the conduct of the affairs of the company since 1899, and since 1913 has been secretary and treasurer.

DAVID B. CRAWFORD

Crawford is well-known in the industry. In 1890 he was employed by Bovaird and Seyfang, oil well manufacturers, Bradford, Pennsylvania, leaving that concern to go with Parkersburg. Officers of the Parkersburg Rig and Reel Company, other than Mr. Crawford, are: John M. Crawford, chairman; Casper A. Ruf, vice-president and treasurer; and B. M. Farson, secretary.

Saving MANY DOLLARS

The McNeely Vibrating Mud Screen on the job at South Houston, Texas

SAVE money in 1936 with the McNEELY Vibrating Mud Screen. It maintains a clean, plastic drilling fluid at lowest operating and maintenance cost. Clean mud prolongs the life of pump, valve and swivel parts and protects against stuck drill pipe and caving hole. The McNEELY Vibrating Mud Screen soon pays for itself through SAVINGS effected!

Operators the world over use and recommend the McNEELY Vibrating Mud Screen. For complete details, ask your Supply House or write for catalog.

VERNON TOOL CO., LTD.
2740 East 37th St., Los Angeles, Calif., U.S.A.

Gulf Coast and Mid-Continent Representative
BAROID SALES CO., HOUSTON

EXPORT
The National Supply Corp. - Oil Well Supply Co.

The McNEELY Vibrating MUD SCREEN

Southern States Company Name Changed to Otis Pressure Control, Inc.

The name of the Southern States Company, Inc., of Dallas, Texas, was, on January 1st, changed to Otis Pressure Control, Inc., in order better to identify the firm name with its highly specialized service and equipment for pressure control. The main office of the company is in the Tower Petroleum Building, Dallas, with branches at Oklahoma City, Oklahoma, Houston, Texas, Hobbs, New Mexico, Midland, Texas, and Wellsville, New York.

J. U. Sammis, who until 1930 was connected with H. C. Otis, president of the company, in Shreveport, Louisiana, is again becoming affiliated with the organization as office manager. Prior to taking over his duties he will spend several months in the Oklahoma fields making observations.

Jones & Laughlin Steel Corporation Announces Huge Expansion Program

A $40,000,000 plan for new mills and other improvements and expansion of the works of the Jones & Laughlin Steel Corporation is revealed in a letter to the corporation's stockholders. The plan includes a $25,000,000 strip and sheet mill to be erected in the Pittsburgh Works. The proposed new mill heralds the long-anticipated entry of Jones & Laughlin into the production of strip and sheets. The decision to engage in this branch of steel manufacture was arrived at, according to the letter to stockholders, after a comprehensive study made over an extended period of all the major steel products, and with the conclusion that strip and sheets best meet the need of the corporation's requirements for increased consumer goods.

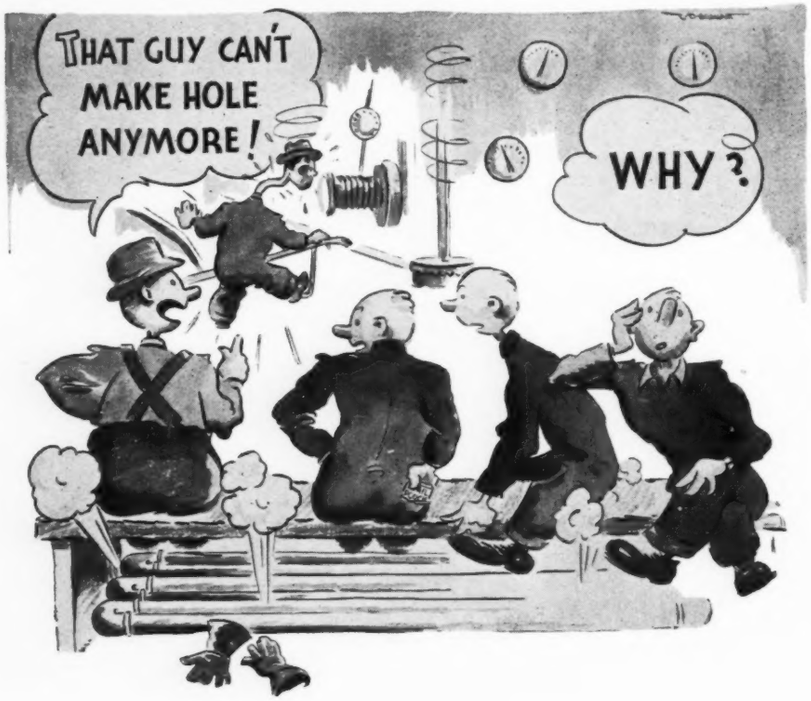
Included in the purposes of the new $40,000,000 financing plan, in addition to $25,000,000 for the new strip and sheet mill, are provisions for working capital required for reimbursement of expenditures already made and yet to be made for the $5,000,000 electrically-driven 44-in. blooming mill in the Pittsburgh Works, already well under construction. Also $1,500,000 for additions and improvements to the four-high cold reducing mill in the Aliquippa Works, $3,000,000 for capital expenditures already made and shortly to be made and for other working capital requirements. At the same time it is proposed to retire the present $5,248,000 of bonds outstanding from an issue of $30,000,000 authorized in 1909, but of which only $25,000,000 were issued and sold.

Gaso Adding to Equipment

The Gaso Pump and Burner Manufacturing Company of Tulsa, Oklahoma, is making important additions to its plant equipment, having recently added four machines to its already large and extensive equipment in order to take care of increased business that has developed in the past several months.

It is announced that Gaso will place on the market, at a very early date, a new pump that will be smaller than any Gaso pump so far introduced. The new pump will be especially adapted for service in core drilling and on pipe lines where a small capacity and high pressure are required.

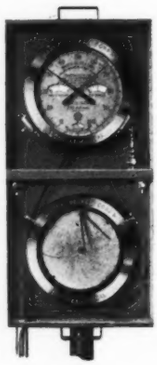
The Gaso Pump and Burner Manufacturing Company has specialized in the manufacture of oil industry pumps for 20 years, and Gaso pumps are in use in every oil district in the world.



"Cause, he's got a bad case of Swivel Neck from watchin' them gauges scattered from hell to breakfast."

"Quintuplex will fix him up tho! . . and quick."

"Yes, Mr. Operator, Quintuplex centralizes drilling control gauge and recorder equipment, making your drillers more efficient. Every change in the drilling operation is instantly reflected on the five centralized Quintuplex instruments."



THE WEIGHT INDICATOR
MARTIN DECKER CORP.
LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Oildale, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Tex.

Oil Well Supply Company Personnel Changes

The following changes in personnel have been made by the Oil Well Supply Compay, effective January 1, 1936:

J. H. Foster has been appointed general attorney, with headquarters in Dallas, Texas.

Paul P. Findley has been elected secretary and appointed assistant general attorney, with headquarters in Dallas.

R. C. Stamets has been appointed manager of the tubular goods department, midwest division, with headquarters in Dallas.

G. E. Niver has been appointed manager of the export division, with headquarters in New York City.

Charles L. Lockett, Jr., has been appointed manager of sales for the export division, with headquarters in New York City.

E. W. Criswell has resigned as secretary and general attorney to become secretary of National Tube Company, with headquarters in Pittsburgh, Pennsylvania.

H. J. Morlang has resigned as a vice-president to become vice-president in charge of sales of oil country goods of National Tube Company, with headquarters in Dallas, Texas.

J. E. Goble has resigned as manager of the export division to become vice-president in charge of sales of National Tube Company, with headquarters in Pittsburgh.

E. W. McMullen Made Director of Research Eagle-Picher Lead Co.

Earle W. McMullen recently was named director of research of the Eagle-Picher Lead Company, succeeding Dr. John A. Schaeffer, who resigned to become president of Franklin and Marshall College.

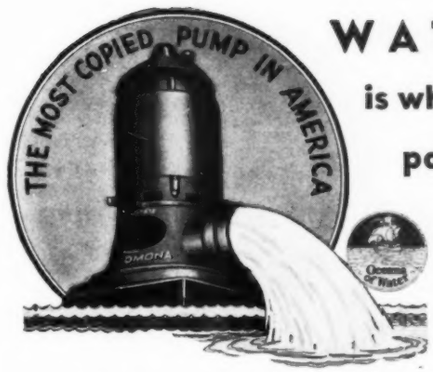
EARLE W. McMULLEN

McMullen brings to his new position a wide and varied experience that should prove extremely valuable in helping him direct Eagle-Picher Lead Company's diversified research activities.

Since 1909, when McMullen graduated from Armour Institute of Technology with the degree of Bachelor of Science in chemical engineering, he has been active in various phases of theoretical and practical research, both in the organic and inorganic fields. His early work as instructor in metallurgy at Armour Institute, his 15 years experience as director of research and technical processes at the Simmons Company, plus his later work on insulating products with the Celotex Company, especially qualify him to fill his new duties most capably.

McMullen is also well known to the paint fraternity for his work on varnish finishes and lacquers. In this field he has co-operated with the A. S. T. M. and other technical associations in standardizing specifications and serving as an expert in legal cases involving these products.

McMullen was vice-president and plant manager of the Ault and Wiborg Corporation, and in accepting his position with Eagle-Picher, he leaves a host of friends who wish him well in his new work.



WATER is what you pay for

Don't buy unknown factors too!

When you purchase a pump you buy it for ONE purpose,—to supply water. Obviously, you don't want it to give you anything but WATER. You do not care to include unwelcome and premature repairs or inadequate volume with your purchase. You want water,—AT LOWEST COST. With a Pomona you buy exactly what you pay for,—WATER,—the cleanest, purest supply,—uninterrupted service for years to come.

Pomona is widely imitated but never successfully duplicated. Mechanical excellence and the use of highly developed materials assure longer life in Pomona Pumps. The cost of power is permanently less because of high sustained efficiency.

POMONA PUMP CO.

53 W. Jackson Blvd., Chicago • 206 E. Commercial St., Pomona, Cal.

POMONA TURBINE PUMPS

Complete, dependable throttling *controls* both flow and pressure

CF V-Port Motor Valve

With flow controllers and instrument-type auxiliary-controlled pressure regulators and with many other forms of refinery equipment, the "V-Port" gradual-opening valve here shown is thoroughly approved and altogether trustworthy. It has various applications also in other industries. Furnished for either direct action (valve closed by diaphragm pressure) or indirect action (valve opened by diaphragm pressure). Sizes from ½-inch up, all with ample diaphragm areas to assure positive, unfailing response of the mechanism. *Write for descriptive circular No.* 3259.

THE CHAPLIN-FULTON MFG. CO.

28-40 PENN AVENUE PITTSBURGH, PA.

Important Sales Meeting Merco Nordstrom Valve Company

For the purpose of giving members of their sales organization an opportunity to study new developments in valve manufacturing processes, the Merco Nordstrom Valve Company recently arranged for a session of several days at the plant in Oakland, California. Under the direction of Colonel W. F. Rockwell, president, a number of the sales staff, comprised of members from various parts of the country, first attended the A.P.I. sessions in Los Angeles, then made an extensive trip through the California oil fields requiring several days, and concluded the tour with a week of study and conferences at the Oakland plant.

Several late developments in the manufacture of Nordstrom lubricated valves were demonstrated to the visiting members. Extensive plans were made for widening the distribution of the company's valves during 1936.

Among those who attended the sales sessions at the plant, in addition to Colonel Rockwell, were L. A. Dixon, vice-president, Pittsburgh; Sven J. Nordstrom, consulting engineer, Oakland; Arthur J. Kerr, manager of the Mid-Continent area, Tulsa; Walter H. Davis, vice-president, Oakland; P. S. Williams, plant manager, Oakland; James Baker, Houston; F. K. Spurrier, experimental engineer, Oakland; H. Boezinger, district manager, Los Angeles; George F. Scherer, director of research, Oakland; Cliff H. Wyman, manager, Chicago; Ed E. Matheson, district manager, San Francisco; F. H. Ricker, production manager, Oakland; Russ Waters, manager, Bakersfield; E. E. Hedene, chief engineer, Oakland; R. F. Cleary, manufacturing cost department, Oakland; S. T. Pollak, manufacturing standards department, Oakland; W. J. Menefee, purchasing department, Oakland, and J. L. Walden, production department, Oakland.

During the conferences in Oakland, members of the organization were hosts to a large number of oil and gas company officials who attended the A.P.I. sessions in Los Angeles and visited the Oakland plant to observe the improved methods of manufacturing valves.

Reading left to right—BOTTOM ROW: S. T. Pollak, manufacturing standards department, Oakland, California; M. H. Weston, sales department, New York, New York; P. S. Williams, plant manager, Oakland; James Baker, sales department, Houston, Texas; F. K. Spurrier, research, Oakland; E. E. Matheson, district manager, San Francisco; A. J. Kerr, Tulsa, Oklahoma, manager Mid-Continent area.

CENTER ROW: R. F. Cleary, manufacturing cost department, Oakland; F. H. Ricker, production manager, Oakland; L. A. Dixon, vice-president, Pittsburgh, Pennsylvania.

TOP ROW: G. F. Scherer, director of research, Oakland; J. L. Walden, production department, Oakland; E. E. Hedene, chief engineer, Oakland; Walter H. Davis, vice-president, Oakland; Colonel W. F. Rockwell, president, Pittsburgh; S. J. Nordstrom, consulting engineer, Oakland; W. J. Menefee, purchasing department, Oakland; Russ Waters, sales department, Bakersfield, California; C. H. Wyman, sales department, Chicago, Illinois, and H. Boezinger, district manager, of Los Angeles, California.

Oil Show Will Bring Many Visitors to Houston

Oil men from all over the world will be in attendance at the Seventh Annual Oil Equipment and Engineering Exposition in Houston, Texas, April 20 to 25, inclusive. Equipment for all branches of the petroleum industry will be on display with exhibits of tools and machinery for drilling, production, refining, pipe lines, and natural gasoline manufacture offering oil men an opportunity to study the latest designs. With Houston recognized as the center of a most active oil area, men interested in every phase of petroleum activity will visit the Houston Oil Show during the week of April 20 to 25. This show has the advantage of being located in the very heart of a territory where most extensive use of modern methods and equipment are to be found. It, therefore, can provide a means for examination of the equipment and for study of its application under actual field conditions.

E. G. LENZNER

E. G. Lenzner, president and general manager of the Oil Equipment and Engineering Exposition, advises that all exhibiting space will be taken. Due to the better condition of the industry, the exhibits, moreover, will be more complete in details and in attractive displays than at any previous show, he states. Outside space will be provided for demonstration work as well as for the showing of derricks, cooling towers, and equipment displays too large for inside showing.

The management is providing for reduced fares for visitors and for reduced freight rates for exhibitors. Considerable attention is being paid to foreign visitors and individual letters of invitation have been sent to officials of oil companies all over the world. A big percentage of oil equipment used in other countries is of American manufacture and representatives from all oil producing countries will learn about

the latest designs in tools and machinery at the exposition.

A joint resolution was introduced into the House of Representatives during the first session of the 74th Congress by Mr. Eagle to authorize "the President to invite the States of the Union and foreign countries to participate in the Oil Equipment and Engineering Exposition at Houston, Texas, to be held April 20 to 25, inclusive, 1936." This resolution also provides for the importation of foreign equipment for exhibition purposes and gives the oil men and manufacturers the opportunity to study any such equipment that may be displayed.

As a special feature that will be provided, in addition to the exhibition of equipment, many will especially emphasize the application of scientific and engineering principles for greater efficiency in oil operations. Considerable attention also will be given to safety in all branches of the industry and a most comprehensive program of first aid work is being worked up.

Another feature that should attract a great deal of attention is the exhibition of new inventions and patents. These displays will be of interest to oil men, manufacturers, and inventors, since they show the trend of equipment design and offer the opportunity to manufacturers to aid in the development of sound ideas. The oil industry is becoming more scientific and more efficient. Equipment for actual field application, however, must be practical; a display of new inventions, therefore, furthers the combination of technical and practical principles.

Attendance at the show will be confined mainly to those connected with the industry. Free tickets will be provided for oil men so that they can attend the exposition as often as desired. All exhibitors are provided with a supply of such tickets in addition to those furnished to the various oil companies.

According to Lenzner, the interest shown in the past contests held in connection with the Oil Show has warranted provision for additional prizes during the 1936 exposition. Keen rivalry has been displayed in the first aid contests and the competing teams are planning on more intensive work than ever before. These contests have resulted in greater efficiency in safety work and much of the hazard connected with field and plant operations in the Gulf Coast and other Texas areas has been eliminated. The prizes awarded the winning teams are cherished; and some of the first aid teams already have started special training for the contests.

Many of the exhibitors also have indicated that more attention will be given to the appearance of their displays. Prizes are to be awarded for the best exhibits, with due consideration being taken of the effectiveness of presentation as well as of beauty. Many will have moving exhibits to show the operations of their products under actual working conditions.

Other prizes will be offered for demonstration work and for other features during the week of the show. Of special interest among the demonstration features will be the fighting of fires, both in oil fields and in refineries.

The Houston hotels are co-operating with the Oil Equipment and Engineering Exposition by making reservations for rooms without raising the rates.

National Tube Company Opens Dallas Office

The National Tube Company announces the opening on January 1st of a district sales office in the Magnolia Building, Dallas, Texas. F. O. Young, formerly in charge of the St. Louis, Missouri, office, has been appointed manager of sales at Dallas. The announcement was made by J. E. Goble, vice-president of National Tube Company, Pittsburgh, Pennsylvania.

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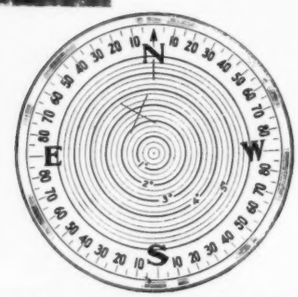

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Crane Company Establishes New Division

M. W. LINK

In order to maintain and enhance progress in its diversified fields, and to foster the invention of new products, Crane Company, Chicago, has established a division of research and development. The importance and volume of research and development work warrants the constant full-time effort of a group of technical specialists entirely divorced from routine production, it was felt. They will devote their entire time to a study of the requirements of the trade; with freedom to pursue the research designing and experimental work necessary to improve existing products, and to develop original designs and materials for new products.

B. A. PARKS

The research and development work formerly handled by various departments and subsidiaries will be expanded and centralized in the new division, which will be responsible directly to the president, with the vice - president of manufacture and the vice-president of sales acting in a coordinating capacity.

The character of work covered by the new division is indicated by some of the units that it comprises. There will be one for field research, separate units for research and development on industrial products, plumbing products, and heating products. Separate laboratories for research testing and metallurgical research. One unit will be devoted to standardization programs, and another to patents and inventions.

M. W. Link will head the new division, with the title of director of research and development. His assistant will be B. A. Parks. Specialized work will be under the charge of

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National Tube Company Announces Appointments

The National Tube Company, Pittsburgh, Pennsylvania, has made announcement of three appointments effective as of January 1st, as follows:

(Blank & Stoller Photo)
HARRY J. MORLANG

H. J. Morlang has been appointed vice-president of National Tube Company in charge of sales of oil country goods, with headquarters at Dallas, Texas. He was formerly vice-president of Oil Well Supply Company, Dallas, Texas.

(Blank & Stoller Photo)
J. E. GOBLE

J. E. Goble has been appointed vice-president in charge of sales of the National Tube Company with headquarters at Pittsburgh, Pennsylvania. He was formerly manager of the export division of Oil Well Supply Company, New York City.

(Blank & Stoller Photo)
W. F. McCONNOR

W. F. McConnor has been appointed general manager of sales of the National Tube Company with headquarters at Pittsburgh, Pennsylvania. He was formerly assistant general manager of sales of National Tube Company.

Lucey Products Corp. Opens Store At Stonewall, Oklahoma

Lucey Products Corporation announces the opening of a new store at Stonewall, Oklahoma. The new location is 12 miles southeast of Ada, in the center of the southeasterly trend of the Fitts pool. Although the Ada store is closed, the Ada property is retained, and will be used for a distributing warehouse and pipe storage.

A. M. Houser, engineer of standardization, C. A. Olson, research engineer, industrial and heating products, R. H. Zinkil, research engineer, plumbing products, J. P. Magos, testing engineer, research testing laboratories, and J. O. Lange, engineer of patents.

Announcement also is made of the creation of a new product engineering department at the Chicago Works under the jurisdiction of the vice-president of manufacture. The initial personnel will be C. A. Dopp, product engineer, A. M. Houser, Jr., assistant product engineer, and C. F. G. Neuhaus, drafting supervisor.

There will be close association between the division of research and development and the product engineering department, so that the latter may place in proper production the products or improvements in existing products developed by the division of research and development.

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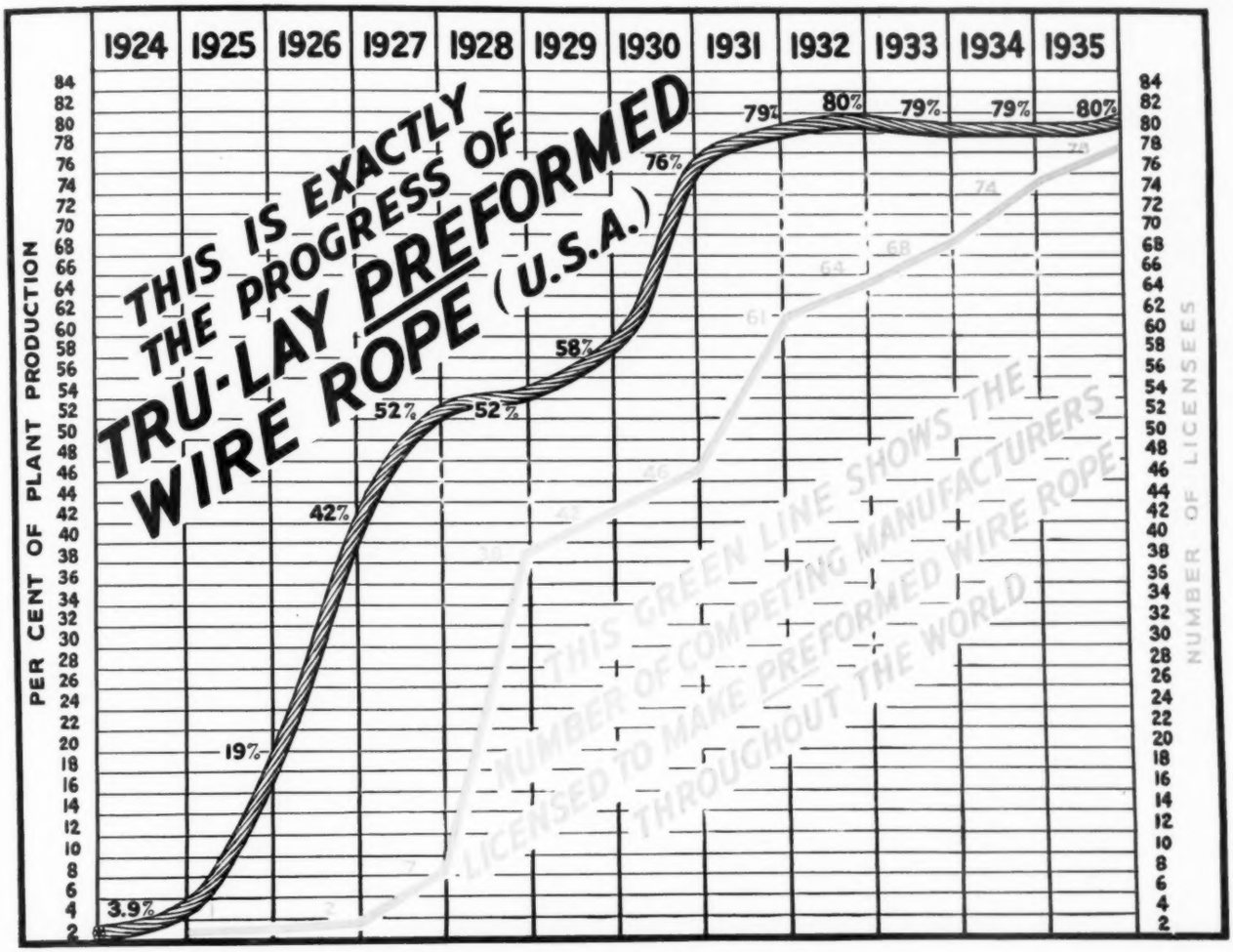

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